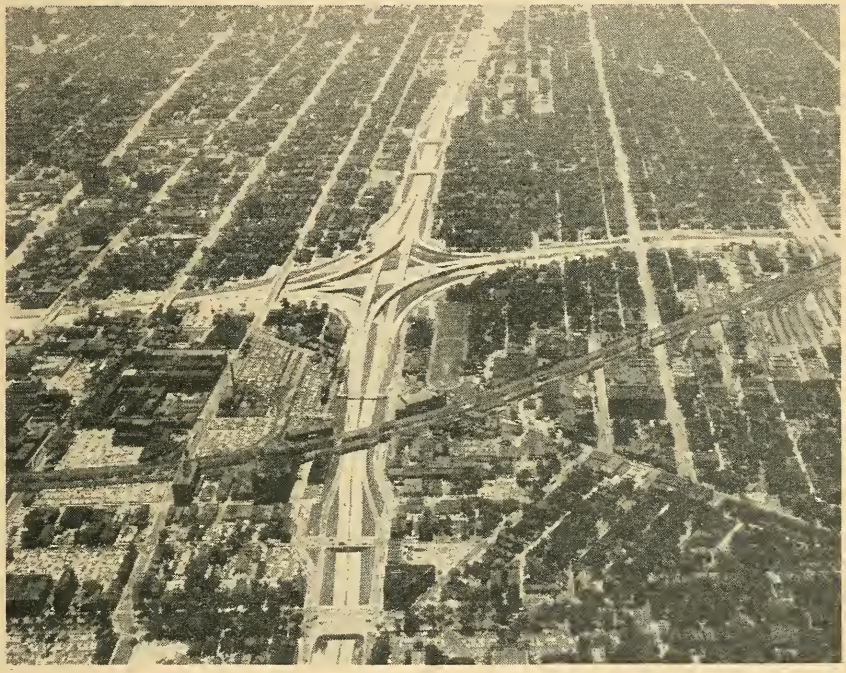
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ANNUAL REPORT

Bureau of Public Roads

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SINCLAIR WEEKS, Secretary

BUREAU OF PUBLIC ROADS

CHARLES D. CURTISS, Commissioner

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ANNUAL REPORT OF THE BUREAU OF PUBLIC ROADS

Factors Affecting Progress

FEDERAL-AID HIGHWAY IMPROVEMENT and all other highway work went forward at a record-breaking rate during the fiscal year 1955.[1] Continued growth in highway traffic with corresponding increase in motor-vehicle revenues for highways, successive increases in Federal-aid authorizations in 1952 and 1954, building of toll roads, and other factors combined to make the year one of great physical accomplishment. Capital expenditures for highways in the calendar year 1954 were estimated at close to $4 billion and expenditures for 1955 were forecast at $4.6 billion. In these years Federal funds constituted 12.3 percent and 13.3 percent of total current highway revenues.

In the fiscal year Federal funds were used in the construction of 22,155 miles of highway at a total cost of $1,280,492,334, the Federal contribution being $671,230,969.

Labor was in good supply. The same was true for materials with some regional exceptions. Improvement of equipment for roadbuilding continued, with manufacturers offering a wide variety of laborsaving, special-purpose tools and machines. During the year costs to contractors for labor increased 5.8 percent; materials, 3.5 percent; and equipment, 2.0 percent; the weighted average increase being 4.2 percent. However, there was a slight decline in bid prices during the year due to greater productivity of labor and equipment and keener competition in bidding.

During the year 6,059 contracts for Federal-aid highway projects were awarded to 2,523 firms, averaging 2.4 per contractor. The number of contracts increased 20 percent above the previous year, the value of contracts increased 28 percent, and the number of contractors increased 10 percent.

The significant feature of the year was not the record accomplishment in construction. Although the volume of construction was great, this was completely overshadowed in the public mind by the greater mileage of improvements, needed to remove congestion, delays, and accidents, which were not made and were not in prospect of being made.

For years the Bureau and numerous highway agencies have pointed to the growing highway deficiencies and urged that highway needs be measured, the cost of meeting them determined, and funds provided to do the job within a reasonable period of years. This has resulted in some increase in highway funds but there has been no real solution of the problem. Everyone has agreed that highway conditions were bad—that something should be done—but there has been no compelling demand from the public that the whole broad problem be faced and measures adopted that would provide a complete solution.

It is believed that the beginning of this process took place during the year. Active consideration of highways as a pressing national problem was touched off in an address delivered in behalf of President Eisenhower at the Governors' Conference on July 12, 1954, by Vice President Nixon. Speaking from the President's own notes, he called for cooperation in formulating and authorizing a vastly expanded highway program.

[1] The fiscal year extended from July 1, 1954, to June 30, 1955.

On September 7, 1954, appointment of the President's Advisory Committee on a National Highway Program was announced. The committee, headed by Gen. Lucius D. Clay, was requested to study the problem, working with the Special Highway Committee of the Governors' Conference and with the Interagency Committee within the Federal establishment. A comprehensive report outlining highway needs, with recommendations as to how they should be met and a plan of financing, was submitted to Congress in February 1955.

Legislation to effect the recommendations of the President and alternate proposals to accomplish the same broad purpose were major questions before the 1st session of the 84th Congress. Extensive hearings were held and problems involved were discussed in magazines and newspapers throughout the country. Differences of opinion were largely as to how the program should be financed. Legislation failed of enactment in the closing days of the session but not in a manner to indicate final defeat of the broad purpose of providing adequate highways.

There were indications that legislation would be reconsidered at the next session.

Throughout the period of intensive public study and debate the Bureau was constantly called upon for basic factual information necessary for intelligent study of the problem. As a result of an earlier directive from Congress, the Bureau was able to supply the President's Advisory Committee with data as to the extent of needs on the various highway systems. Four separate reports on highway matters were presented to Congress and considered by committees. When committees began to consider specific legislation, the Bureau was called upon repeatedly to prepare statistical reports showing the division of proposed funds among the States according to various methods of apportionment, analysis of bond financing and retirement proposals, and the yield of possible sources of revenue over a period of years.

Reports to Congress

Needs of the highway systems

The Federal-aid Highway Act of 1954 directed that there be made a comprehensive study of highway financing, including a study of the cost of completing the several systems of highways and of the feasibility of toll roads, and a report made to Congress. Evaluating needs on the 3.4 million miles of rural roads and city streets was an enormous job accomplished only through the intensive efforts of the highway planning organizations of the States.

The report submitted to Congress in March 1955 (House Document 120, 84th Congress, 1st session) shows the cost of construction needed to modernize the Nation's roads and streets in a period of 10 years to be $101 billion. This is the estimated cost of improvements by all highway agencies on all highway systems, serving 58 million vehicles in 1955 and expected to serve 81 million vehicles in 1965.

Needed work on the 37,700 miles of the National System of Interstate Highways during a proposed 10-year period of improvement was placed at $23.2 billion, of which $12.5 billion was for work in rural areas and $10.7 billion in urban areas. Such expenditures would make this entire network structurally adequate and provide sufficient lane width to carry traffic predicted for 1974. The bulk of the proposed improvements, more than 28,000 miles, would be 4-lane divided highways. About 2,300 miles in and approaching the heavier populated areas were said to require 6 or more lanes. The report stressed the importance of immediate improvement of the system as a national peacetime need and as a defense measure.

Feasibility of toll roads

Progress and feasibility of toll roads and their relation to the Federal-aid system was reported to Congress in April 1955 (House Document No. 139, 84th Congress,

1st session). Highways feasible of construction as toll roads were found to be almost entirely along the routes of the National System of Interstate Highways. This system included all but 200 of the 6,900 miles regarded as feasible for additional toll-road construction.

The report recommended continuance of the present law forbidding the collection of tolls on highways constructed with Federal-aid funds. It also recommended that the present law be changed to permit inclusion of toll roads as part of the Interstate system when they meet the standards for that system and there is a reasonably satisfactory alternate free route on either the Federal-aid primary or secondary system.

The report discussed the adverse effects of toll roads on the programing of public highway improvements and the many problems of integration of toll roads with the public highway network. The report stated that these problems would be alleviated if responsibility for toll roads were vested in State highway departments.

Public utility relocation incident to highway improvement

A report on the cost of relocation of public utilities necessitated by highway improvement and the legal relations which may affect distribution of the cost was presented to Congress in April 1955 (House Document 127, 84th Congress, 1st session).

Traditionally, public utilities have established themselves along and within public highway rights-of-way. In general, the status of these installations has been covered by State constitutional or statutory authority. As a rule, where highway improvements require it, the public utility facilities are removed from one location within the highway right-of-way to another at the expense of the utilities themselves. As highway improvement and modernization increased, the utilities have claimed that these relocation costs imposed a greater and greater burden.

The State highway departments reported that the total dollar value of all highway projects completed in the survey year 1953 was approximately $1.7 billion and involved 10,245 highway projects, aggregating 40,027 miles in length. The public utilities which cooperated in the study reported that they could identify 5,422 utility relocations in connection with 3,836 of these highway projects. The dollar value of the construction of these projects amounted to about $1.1 billion and involved nearly 14,000 miles of highway.

The utilities reported relocation costs for the year amounting to $35.5 million. More than 80 percent of this cost ($29.1 million) involved utilities located within the highway right-of-way. The remaining 20 percent ($6.4 million) was the cost of moving utilities located on their own private rights-of-way, for much of which they were reimbursed in the same manner as any other property owner.

Revision of Federal-aid highway laws

The Bureau has operated under Federal-aid highway law consisting of a series of amendments and supplements to the original Federal-aid Road Act of 1916. At least 36 separate enactments have modified the laws governing the Federal-aid program since its inception about 40 years ago. It was inevitable that various overlappings, conflicts, and duplications would creep into the large body of law accumulated over that period. There has been urgent need for a clear, unified, and up-to-date version of the Federal-aid highway laws.

Recognizing such need, Congress, in the Federal-aid Highway Act of 1954, directed the Secretary of Commerce to submit to Congress a suggested draft of a revised Federal-aid highway law which would incorporate the substantive provisions of existing law, together with such clarifying modifications as were deemed desirable. To accomplish the desired objective, the Bureau made a thorough analysis of all the Federal-aid highway enactments. Suggestions were invited from operating officials in the Washington and field offices. Upon the completion

of this study, a report, including a draft of a proposed new "one-package" law, was submitted to Congress in December 1954 (House Committee Print No. 1, Committee on Public Works, House of Representatives, 84th Congress, 1st session).

Bills were introduced in both Houses, based on the Bureau's report, but action on these bills was deferred pending final action on the President's highway program. It was anticipated that the pending legislation would be considered at the next session of Congress.

The Federal-aid Program

The Federal-aid highway program accelerated considerably during the year as the result of an increase in the annual authorization rate from $575 million annually to $875 million, and an early apportionment of the 1956 funds, effective July 1, 1954. This was 6 months in advance of the required apportionment date and followed the apportionment of the 1955 authorization by only 6 months. The $875 million of Federal-aid funds authorized for the fiscal year 1956 and remaining balances of prior authorizations, together with State and local matching funds, financed the program carried forward during the year.

Completions of all classes of Federal-aid projects during the year accounted for the improvement of 22,155 miles of roads. Included were 6,050 miles of highways and 1,202 bridges on the Federal-aid primary highway system outside of cities, 842 miles of highways and 465 bridges on urban portions of the Federal-aid primary highway system, 14,692 miles of roads and 1,764 bridges on secondary or farm-to-market roads, and 571 miles of highways in National forests, parks, and parkways, and on flood-relief projects. The long-range program of eliminating hazards at railway-highway grade crossings was advanced during the year by elimination of 216 crossings, reconstruction of 38 inadequate grade-crossing structures, and protection of 317 crossings by the installation of flashing lights or other appropriate safety devices.

Practically all States were allotting funds apportioned for the fiscal year 1956 to programed projects. Projects for the construction of 27,451 miles were programed during the year. Contracts were awarded during the year for improvements to 24,009 miles of highways and streets. Construction put in place during the year amounted to 110 percent of the year's $575 million authorization, an increase of 14 percent over the previous year. Construction was under way or scheduled to start soon on 25,157 miles of highways and streets at the year's end. Tables in the appendix show details of accomplishments during the year and status of the program at the end of the year.

Classes of Federal-aid Work

Federal-aid highway authorizations since World War II have provided Federal funds for three classes of highways—primary, secondary, and urban. A total of $550 million was authorized for these three classes of highways for each of the fiscal years 1954 and 1955 by the Federal-aid Highway Act of 1952. In addition, authorizations of $25 million each year were made for improvements to the National System of Interstate Highways. The annual authorization for primary, secondary, and urban highways was raised to $700 million for the fiscal years 1956 and 1957 by the Federal-aid Highway Act of 1954. The act raised to $175 million annually the rate for the National System of Interstate Highways.

Federal-aid primary highway system

Federal funds for the Federal-aid primary highway system have been provided continually since the Federal-aid Highway Act in 1921 made provision for its designation. The system is made up of the principal highways of the Nation and includes 216,246 miles of rural highway and 17,902 miles in urban areas. Primary

fund authorizations amounted to $247.5 million for each of the fiscal years 1954 and 1955 and $315 million for each of the fiscal years 1956 and 1957. These funds are available for improvement of both rural and urban portions of the primary system.

Federal-aid secondary highway system

The Federal-aid secondary highway system includes important farm-to-market routes, rural mail routes, and school bus routes. The system as designated at the end of the year included 507,676 miles. Funds for secondary routes have been included regularly in Federal-aid authorizations beginning with the fiscal year 1938. Secondary fund authorizations amounted to $165 million for each of the fiscal years 1954 and 1955 and $210 million for each of the fiscal years 1956 and 1957.

Federal-aid primary system in urban areas

The Federal-aid primary highway system in urban areas is 17,902 miles in extent. Federal funds have been provided specifically for improvement of these urban routes continually since 1946. Provision of this separate authorization for urban work evidenced congressional concern over the urban traffic problem. Urban fund authorizations amounted to $137.5 million for each of the fiscal years 1954 and 1955 and $175 million for each of the fiscal years 1956 and 1957. Approximately one-seventh of all primary funds allotted to projects have been utilized for improvements in urban areas. A provision of the 1954 act made urban funds available also to finance improvements on urban extensions of the Federal-aid secondary system. Previously there had been no provision whereby Federal funds could participate in improvements to these urban extensions.

National System of Interstate Highways

The National System of Interstate Highways is an integrated network of routes that connect our country's principal metropolitan areas, cities, and industrial centers, serve the national defense, and connect at suitable border points with routes of continental importance in Canada and Mexico. As such, the system includes most of the heaviest-traveled main arteries of the Nation.

Interstate system routes are included in and constitute the most important portions of the Federal-aid primary system. The Interstate system is limited by law to 40,000 miles of which 37,682 miles were designated at the end of the fiscal year. The system was being reviewed during the year for the purpose of designating the remaining mileage, which is expected to be utilized principally for urban connections.

The Federal-aid Highway Act of 1952 provided the first Federal funds authorized specifically for improvements to the Interstate system. The $25 million authorization for each of the fiscal years 1954 and 1955 was made available on the regular matching basis of 50-percent Federal and 50-percent State funds. The annual authorization rate was raised to $175 million by the Federal-aid Highway Act of 1954 for each of the fiscal years 1956 and 1957. The matching basis for these funds was revised to provide 60-percent Federal and 40-percent State shares.

Status of Work at End of Fiscal Year

Improvements to 23,902 miles of highways and streets and construction of 5,015 bridges were included in the active Federal-State cooperative program at the close of the fiscal year (table 2 of appendix). This work was included in projects for which plans had been approved or construction had been started but was not yet completed. The estimated total cost of this work was $2.1 billion, including $1.08 billion of Federal funds. Grade-crossing work included in the active program consisted of 382 railway-highway grade-crossing eliminations, reconstruction

of 43 inadequate grade-separation structures, and the protection of 288 railway-highway grade crossings by installation of flashing lights or other appropriate safety devices.

The active program of highway improvements in National forests and parks, public lands, and the restoration of flood-damaged roads and bridges involved improvements to an additional 1,255 miles at a total estimated cost of $63.9 million, of which $56.3 million were Federal funds.

The National System of Interstate Highways

Since its establishment in 1947, improvements of the Interstate system have been financed largely with regular Federal-aid primary and urban funds matched and supplemented by State funds. The States have recognized the importance of this system by applying 27 percent of total primary funds and 45 percent of total urban funds since World War II to improvement of the Interstate system. A total of $2.1 billion of primary and urban Federal-aid funds and State matching funds have been applied. In addition $162 million of Interstate funds and State matching funds have been allotted to Interstate system improvements. The States have also improved sections of the system without Federal aid.

Improvements to the Interstate system have been widespread. Numerous sections of 4-lane divided highways have been constructed in nearly every State and construction of freeways has begun in nearly all of the large cities on the system. However, progress has been slow in comparison to the growing need and is far below the rate required to provide urgently needed highway facilities. The need for acquiring full control of access of all projects in the Interstate system has been widely recognized and accepted.

A study of the cost of improving the Interstate system is discussed under the heading *Reports to Congress.*

In the fall of 1954, the States were urged to identify final detailed locations of routes susceptible of ultimate development to the standards adopted for this system. By the end of the fiscal year 5,500 miles of final locations in 36 States had been approved.

In the spring and early summer of 1955, the States were canvassed to determine their desires for designation of the remaining 2,300 miles of the 40,000 miles authorized by the Congress. The proposed designations were reviewed with the Department of Defense, and criteria established governing routes which could qualify. Consideration was not given to new routes interconnecting cities because such routes were established by cooperation between the States and the Bureau and officially designated in August 1947. The States' proposals for routes within and around cities, for which the 2,300 miles had been reserved since 1947, were being analyzed at the end of the year. It was expected the 2,300 miles would be designated in the near future.

Improvement of Urban Highways

At the end of the year, 10 years had elapsed since the inauguration of the program for Federal aid in the improvement of urban highways. The Federal-aid Highway Act of 1944 authorized a special class of funds for urban areas in addition to such portions of regular Federal-aid primary funds, and in some States, Federal-aid secondary funds, as the States assigned for urban highways.

The extent of Federal-aid improvements in urban areas has increased gradually over this 10-year period, starting with the approval of plans for work valued at about $50 million in the first year, and increasing to almost $500 million during the fiscal year ending June 30, 1955. During this decade, on the basis of plans approved, the Federal-aid work in urban areas totaled almost $3 billion, of which

about $1.4 billion was Federal-aid funds, involving over 7,000 miles of highway improvements and some 3,780 bridges. In addition, protective devices were added or structures were modernized at over 400 railway-highway grade crossings, and hazards were eliminated at about 700 crossings by construction of railway-highway grade-separation structures.

For the fiscal year 1955, Federal-aid urban funds were 24 percent of the total authorized for all classes of Federal-aid work. All of these funds necessarily were spent within urban areas. In addition, about 20 percent of the Federal-aid primary funds were used on projects in urban areas. Including small amounts of other funds, the total work in urban areas accounted for nearly 32 percent of all classes of funds.

During the year, programs were approved for projects in urban areas with total cost estimated at $459 million, the Federal contribution to be approximately $236 million. Work completed during the year involved a total of $430 million for 842 miles. The Federal contribution was $218 million. In selecting the projects for improvement with Federal-aid urban funds, every effort was made to eliminate traffic bottlenecks by construction that provided increased traffic capacity. Improvements which included median dividers to separate opposing traffic absorbed over three-fourths of the urban funds. About two-thirds of the urban funds were for construction of facilities that had expressway characteristics.

Because of the complexities of fitting a substantial urban highway improvement in the midst of a developed community, and the attendant high cost for rights-of-way and construction, extensive and time-consuming engineering studies have been found necessary. In the usual sequence the successive study steps are broad-scale planning of routes, traffic studies, study of alternate locations for improvement, preliminary plan development based on traffic estimates, and preparation of construction plans and the acquirement of right-of-way.

During the year, work continued on all phases of engineering for future urban projects. Many State highway departments had only limited engineering personnel trained or experienced in the planning and design of urban highways. While consulting engineering services have been used to some extent for many years, it appeared that the highway departments would utilize them to a greater extent on urban design. State highway departments committed approximately $3.5 million for fees to engineering firms covering the cost of surveys, design, and preparation of plans for Federal-aid projects. This amount was substantially larger than in former years.

There was increasing emphasis on planning and location studies for routes to be developed as a part of the National System of Interstate Highways. In keeping with the overall importance of this system, such routes were being planned as ultimate expressways with full control of access. Intensive engineering study is required to determine where it is feasible to develop such a facility. Where the route must be located to bypass all or part of the built-up urban area, additional studies are needed to establish suitable connections to the traffic foci of the area. Engineering work on such features was started or continued in nearly all large urban areas.

Completion of sections of several major expressways, which had been under construction for several years, permitted the opening of usable sections. Progress was made in plans for initiation of construction of extensions. All cities in the United States of over a half-million population now have at least the initial sections of an expressway system in use. Expressways were being constructed in 44 cities between 100,000 and 500,000 population and in 58 smaller cities. Construction has been started in Boston, Baltimore, Louisville, and other cities, of circumferential routes near the outskirts of the metropolitan areas which will permit a free interchange of traffic between the several radial routes without passing through the more congested areas.

Legislation of 1954 made urban extensions of Federal-aid secondary routes in many States eligible for improvement with Federal aid for the first time. The urban extensions of secondary routes that could be improved with Federal-aid urban funds reached a total of 7,860 miles. This was in addition to the nearly 18,000 miles of primary system extensions in urban areas eligible for improvement with both urban and primary funds. Improvement of extensions of secondary roads consisted largely of widening. Although not as spectacular as the expressway projects, these were substantial improvements of considerable importance to communities.

Improvement of Primary Highways

During the fiscal year, improvements involving Federal-aid primary funds were completed on 6,190 miles of the Federal-aid primary highway system at a total cost of nearly $520,961,518. Completed work involved 4,998 miles of bituminous and concrete surfacing, 1,042 bridges over streams, and 101 bridges over highways to facilitate the free flow of traffic. In the interest of reducing the hazards of travel, 77 railway-highway crossings were eliminated by grade-separation structures, 18 separation structures were reconstructed, and 120 grade crossings were protected by the installation of signal devices.

An additional 7,167 miles of improvements, estimated to cost in excess of $664,491,756, involving $350,024,864 of Federal-aid primary funds, were programed during the year. Plans for many of these proposed improvements and for projects previously programed were approved as submitted by the State highway departments so that at the close of the year 8,699 miles of primary highway improvements, having an estimated cost of $866,025,109, were under construction or ready for advancement to the construction stage. The need of divided highways to provide greater safety for highway traffic was recognized by an increasing amount of such highway construction being included in the Federal-aid highway program.

Secondary or Farm-to-Market Roads

As has happened each year since Federal-aid funds were first made available in substantial amounts for secondary roads, in 1944, improvements completed with Federal-aid secondary funds accounted for more than half of the total miles of all Federal-aid construction. The 14,692 miles completed during the fiscal year bring the total of all improvements completed since 1944 to 110,034 miles. This total, however, includes 18,461 miles of further improvement to once improved roads, so that the net mileage of improvements amounts to 91,573 miles.

The Federal-aid secondary system now comprises 507,676 miles, an increase of 24,704 miles during the fiscal year. All roads in the system were selected by the State highway departments in cooperation with the appropriate local officials prior to consideration and approval by the Bureau. All projects for improvement were selected and the specifications determined by the State highway departments acting in cooperation with each other, with final Bureau approval.

A new plan for administration of the farm-to-market road program, termed the "1954 Secondary Road Plan," was initiated under the provisions of the 1954 act. Under this plan, a State may request that the Secretary of Commerce discharge much of his engineering and administrative responsibility for secondary roads by accepting a certification by the State that a project has been completed in accordance with the standards and procedures previously approved by the Secretary.

Thirty-one States have now adopted the plan: Alabama, Arkansas, California, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Nebraska, New Hampshire, New York, North Carolina, Oregon, Pennsylvania, South Carolina, South Dakota,

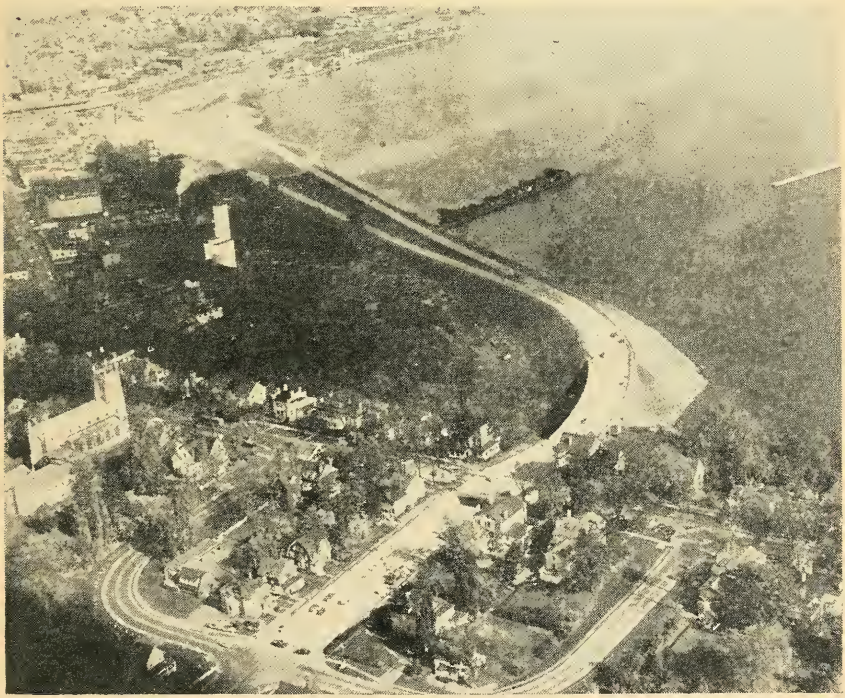
Tennessee, Texas, Utah, Vermont, Virginia, Wisconsin, and Wyoming. Others are expected to follow.

Work on Outstanding Projects

The Federal-aid program included all classes of roads. The mileage improved was made up very largely of 2-lane roads, but expressways with controlled access, 4-lane divided highways, and structures to eliminate highway-highway and highway-railroad crossings at grade absorbed an increasing portion of funds available.

The following projects (with the exception of the two secondary projects described), are typical of the more costly improvements necessary to serve large volumes of traffic.

Arterial route along lake front at Geneva, N. Y.—Construction of an arterial route along a lake or river front is frequently the most practical way of obtaining a wide highway for free-flowing traffic without frequent intersections at grade. The first section of such a highway was completed along the lake front at Geneva, N. Y. It carries U. S. 20 and State Route 5 on new location. This facility permits through traffic to avoid the downtown section of the city which formerly was a bottleneck. Cars, trucks, and buses were forced to creep a few car-lengths at a time through the city streets along a circuitous route over a railroad grade crossing and up and down steep streets filled with vehicles and pedestrians. Now 7,000 vehicles per day move freely and safely along the lake front, avoiding all conflicting traffic movements and diminishing considerably the congestion which formerly prevailed on business streets. The 0.85-mile section includes two grade-separation structures and cost $2.2 million.



Arterial route along lake front at Geneva, N. Y.

Two-level highway in Newark, N. J.—New Jersey State Route 21 carries extremely heavy mixed traffic directly through Newark from the southern part of the city to Belleville, Passaic County, and north. Traffic had to move over congested streets and at times all movements were brought to a standstill. To relieve this situation a two-level road—a viaduct and ground-level highway—was constructed on a 42-foot right-of-way between a large cemetery and a railroad, at a cost of $2.5 million. The elevated roadway has 3 lanes for southbound traffic, and the northbound traffic will use the 3 lanes under the viaduct. The steel and concrete viaduct is 2,000 feet long. To expedite completion, vacuum-processed concrete was used in the deck construction. It was estimated that this improvement would take 34,000 vehicles per day off of the local city streets.

Baltimore-Washington Parkway.—In October 1954 a new 4-lane freeway was opened to traffic between Baltimore, Md., and Washington, D. C. This route, entirely on new location, provided much needed relief for the heavily traveled old U. S. 1 linking the two cities. Intensive industrial and commercial development throughout the entire 40-mile length of the old road made modernization a prohibitively expensive undertaking. The new road has complete control of access on a right-of-way ranging from 400 to 1,200 feet in width, with opposing traffic lanes separated as much as 200 feet by a grassy, tree-studded median. The grading, base, and bridges are all sufficiently wide to permit the addition of two more lanes of pavement when traffic volumes warrant.

Approximately half of the route was built by Maryland as Federal-aid projects and the remainder as a Federal parkway.

Traffic volume counts made at the Maryland-District of Columbia line show that average week-day traffic decreased from 34,800 to 24,000 vehicles per day on the old route soon after the parkway was opened. Week-day traffic using the new route reached 29,600 vehicles per day in April 1955 with the Sunday count in the same month totaling 38,500. The new route reduced travel time by car between the two cities by 20 to 40 minutes depending upon the time of day a trip was made. This reduction in time and the ease with which the trip could be made no doubt accounts in large part for the increase in total number of trips.

Plans are now being prepared to construct a freeway along the west side of the Anacostia River, extending the Baltimore-Washington route southward through the District of Columbia to a connection with a proposed bridge over the Potomac River at Jones Point, south of Alexandria, Va., thus providing a bypass for interstate traffic of the present traffic bottleneck in the Washington metropolitan area caused by use of existing grid streets.

Work was also underway on plans for another freeway around Washington on the east, connecting the Baltimore-Washington parkway with the main route to the south in Virginia via the proposed Jones Point bridge across the Potomac River. Such an improvement would permit interstate traffic to avoid numerous bottlenecks in the Washington metropolitan area.

Atlanta's freeway system.—Atlanta is making rapid progress on a freeway system. The north-south section consists of a main artery and legs to the northeast and northwest, totaling 20.3 miles. All but 2 miles has been completed. The northwest leg carries U. S. 41 and connects with 40 miles of completed 4-lane development. The northeast leg connects with a 10.6-mile section of the Interstate system, under construction to interstate standards with complete control of access. The south leg of the expressway carries U. S. 41 and 19 and connects with 29 miles of 4-lane development. A traffic count on the main north-south leg at the end of the year showed a daily use by nearly 48,000 vehicles.

Detroit expressways.—The first two sections of the Edsel Ford and John C. Lodge Expressways in Detroit were completed during the year. These projects were conceived prior to World War II, but it was not until the passage of the



Expressway in Atlanta.

Federal-aid Highway Act of 1944 that funds were made available for actual construction, which started in 1947. The completed sections provide for the free, unrestricted flow of traffic from the west limits of Detroit to the heart of the business district. Parallel surface streets have been relieved of a tremendous volume of traffic. Both of the routes are urban extensions of the Interstate system.

The completed sections total about 8 miles and provide a continuous 6-lane depressed freeway which carried as high as 117,000 vehicles per day. The interchange at the junction of the two expressways provides for unrestricted traffic flow in all directions. There are 14 structures in the interchange area to permit all the necessary direct turning movements. In addition to the 14 bridges in the interchange there are 48 bridges on the completed sections, carrying railroad, vehicular, and pedestrian traffic over the expressway.

A 6-mile extension of the Lodge Expressway to the northwest city limits and a 9-mile extension of the Ford Expressway from the interchange to the northeast city limits were under construction and scheduled for completion late in 1957. It was estimated that the entire 23-mile improvement will cost $195 million, including right-of-way.

Elevated structure in New Orleans.—Extremely costly construction has been necessary in properly improving U. S. 90 in New Orleans in the vicinity of the Union Passenger Terminal. To avoid conflict with large volumes of highway and rail traffic it has been necessary to construct a viaduct 3,450 feet long at a cost of $5.3 million.



Elevated 6-lane expressway in New Orleans.

Divided roadways, each 40 feet wide, provide for three streams of traffic in each direction. Traffic on the structure had reached 38,800 vehicles per day.

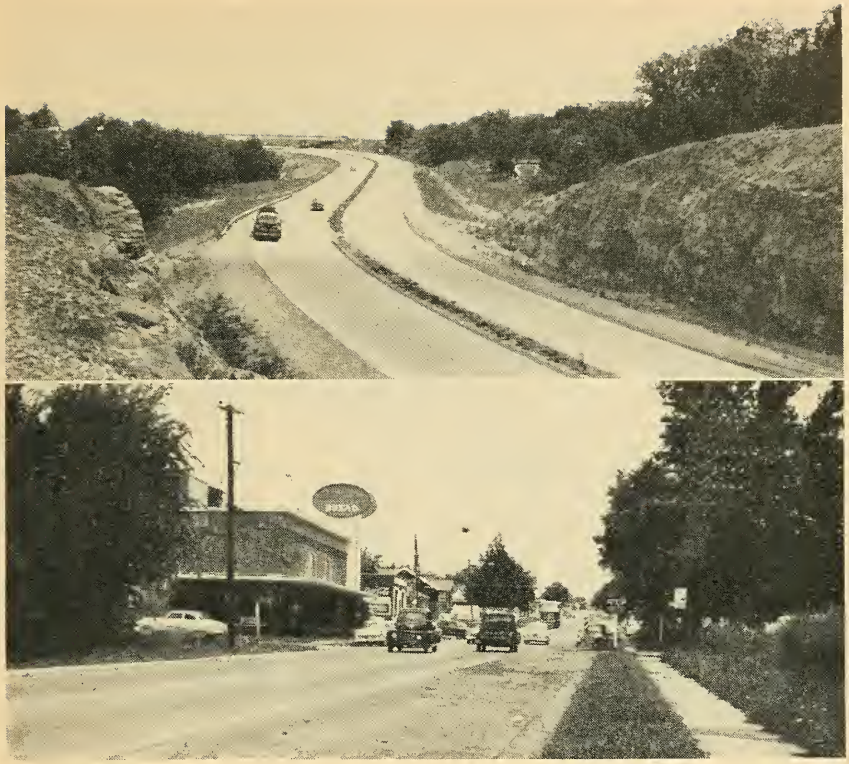
Bypass at Rolla, Mo.—Relocation of U. S. 66 to skirt rather than pass through Rolla, Mo., is an example of the policy necessary in modernizing main highways. The section of highway was to be rebuilt as a final location of the Interstate system. Traffic from St. Louis to Oklahoma and the southwest uses the route. Rolla has a population of 9,354 and is the trading center for a large surrounding area. It is the location of the Missouri University School of Mines and Metallurgy. Fort Leonard Wood is located 30 miles away.

The total traffic was 6,928 vehicles per day, much of it destined for Rolla, but it was decided that the through traffic could not be safely routed through Rolla. Originally, U. S. 66 skirted Rolla but the city had grown to surround it and the route had become a city street. Once again the highway has been moved to the outskirts and this time it will retain its free-flow characteristics. This is assured by full control of access with only two access points. No business will front on the highway with direct access to it.

The 4-lane, divided highway, close to 5 miles in length, is almost ½ mile shorter than the old location. The improvement cost $1.7 million.

The San Bernardino Freeway.—Significant progress was made during the year on the San Bernardino Freeway in California (formerly known as the Ramona Freeway) which extends from a connection with the Santa Ana Freeway in Los Angeles to the San Bernardino area, a distance of approximately 56 miles. It is the established routing of the Interstate system into Los Angeles from the east. Carrying the concentrated flow of traffic to and from the north, east, and south via U. S. 60, 66, 70, 91, 99, and 395, it is one of the most important sections of the Interstate system in California.

Construction was begun on this freeway in Los Angeles in 1934 but the major portion of the work has been done since World War II. At the end of the year construction was underway on a 15.1-mile section scheduled for completion during 1956. Upon completion of this work there will be a continuous section of 4-lane and 6-lane divided roadway 53.5 miles in length between Los Angeles and



Bypass around Rolla, Mo., and the route it replaces.

the westerly outskirts of Colton, near San Bernardino. Construction of a 2-mile section through the city of Colton was scheduled to begin soon.

On new location for the most part, and with control of access, the new freeway avoids the congestion along the old route in several cities and the roadside development that has sprung up in this rapidly growing area. It was estimated that this freeway will enable users to reduce the travel time on the 56 miles between Los Angeles and San Bernardino by about 45 minutes. Much of the old route is posted for reduced speed. Average daily traffic on this route in 1954 ranged from 13,800 vehicles in the rural areas to 80,000 in Los Angeles.

North-south Interstate route in Oregon.—In Oregon, the construction of Interstate highways has been greatly facilitated by a State bond issue of $72 million. With funds from this source, supplemented by Federal aid, approximately one-half of the State's 300-mile north-south Interstate route was being relocated and constructed with full control of access and complete grade separation. An example of the work being accomplished is the 20-mile section of Interstate highway extending from 5 miles south of Eugene southward to Divide. On this section, the new route parallels the former route on the opposite side of a railroad and about one-half mile distant, thereby avoiding the business development and making access control and grade separation practicable. As initial improvement, a 24-foot, 2-lane road was being built. Right-of-way of 225-foot width has been acquired to make widening of the roadway to 4 lanes with wide median strip possible when traffic warrants. The right-of-way was being fenced throughout to assure complete control of access. The cost of the project was estimated at $4.1 million.



San Bernardino Freeway in California.

Vancouver-Olympia highway in Washington.—During the calendar year 1955, the State of Washington expects to open to public travel a modern divided 4-lane, access-controlled highway on U. S. 99 between the Washington-Oregon State line and Olympia, the capital city, a distance of 103 miles. This is a section of the Interstate system. Construction has been underway since 1942. Since 1951 bond financing and Federal aid have accelerated the work. The final paving contract required to complete this section was awarded in June 1955. Paving was underway on more than one-half of the total mileage. The remaining mileage, including the freeway through Vancouver, was completed and open to traffic.

Secondary road in Florida.—From the earliest period in the history of Florida



The Pacific Highway (U. S. 99) in Washington.

until recent years, the vast expanse of the Everglades resisted all efforts toward reclamation and agricultural development. It has been demonstrated that the rich muck lands of the swamps and marshes are potentially one of the most productive all-year truck farming sections in the world. Completion of a flood-control project around Lake Okeechobee in the late 1930's was followed by the first large-scale agricultural development in the Everglades country. As a result of this, there has been a continued demand for more tillable land. Until provision of Federal aid for farm-to-market roads in 1944, no serious attempt was made to construct passable roads in the Everglades, due to construction difficulties and high costs.

In 1947–49 a Federal-aid secondary road extending 8.5 miles eastward from Immokalee was constructed at a cost of $326,000. In the following 6 years the adjacent country was transformed to such an extent as to be unrecognizable as the original site of the improvement. It was changed from typical Everglades wasteland to one of the important farming communities of the State. The population of Immokalee rose from some 300 in 1947 to approximately 900, while traffic on the road increased from less than 10 vehicles per day to 335.

The State, recognizing the importance of this improvement and the current demands for further development, began an extension of 15 miles to the east. Farmers, gambling on the assumption that this section would be completed in time for the watermelon season of May 1955, planted several hundred acres of melons. On 1 day, 18 carloads of melons were hauled by truck over this road.

A Maine secondary road.—Secondary roads in the rural regions of the northeast provide two major traffic services. They furnish local residents of the small villages and farming communities with a means of reaching the primary routes leading to the urban markets and shipping points, and they carry tourists away from the distractions of the heavily traveled primary routes to the lake and mountain vacation areas. Many miles of these roads are still old dirt wagon roads which have been gradually widened through the years and treated with tar to control dust. Federal-aid secondary highway funds are being used to reconstruct these roads to meet rapidly increasing traffic requirements, and some impressive improvements have been made.

A typical improvement is a 4.3-mile section recently completed in Maine. Steep grades were reduced and several blind curves were eliminated. A bituminous pavement on a substantial gravel base and automatic flashing-light signals at a railroad grade crossing were provided. Traversing rural farm country in



Rich farmland opened to use by a secondary road through Everglades swamps.



A secondary road in Maine that serves both farm and recreational traffic.

the famous Belgrade Lakes region, this project furnishes the residents of three villages and adjacent farms with a safe and convenient connection to the trunk-line highway leading to urban markets. It also provides tourist traffic with an inviting route leading to numerous summer camps and cottages on the lakes in the region.

Highway Improvements Under Direct Supervision of the Bureau

Under existing legislation, the Bureau receives and administers annual appropriations for the major highways through national forests, and performs a large amount of highway engineering and construction for other Federal agencies as required by law and as may be requested for specific projects. Agencies of the Government receiving direct appropriations for the construction and maintenance of roads and calling upon the Bureau for assistance are the Departments of Agriculture, Defense, Interior, and State, and the Atomic Energy Commission. During the fiscal year the expenditures for highway work under direct supervision of the Bureau amounted to $37,334,542.

The following tabulation indicates the volume of highway work as of June 30, 1955, in which the engineering and construction services of the Bureau were actively engaged (the figures include estimated costs of work programed, in preparation, and under construction):

Bureau of Public Roads:	
Forest highways	$53, 756, 199
Special Tongass Forest highways (Alaska)	914, 791
Federal lands	454, 754
Miscellaneous access roads	231, 370
National Park Service:	
Park roads	17, 049, 681
Parkways	19, 187, 759
Forest Service: Forest development roads (including beetle-control roads)	12, 612, 907
Indian Service: Reservation roads	4, 000, 000
Department of Defense: Access roads	2, 368, 075
Atomic Energy Commission: Access roads	1, 237, 315
Bureau of Land Management	6, 188, 000
Total	118, 000, 851

Forest highways

Forest highways are main and secondary roads within or adjacent to the National forests. The forest highway system, totaling 24,223 miles, is located in 39 of the 48 States and in the Territories of Puerto Rico and Alaska. The National forests comprise approximately one-tenth of the total area of the United States.

A considerable mileage of the forest highway system is coincident with the Federal-aid and State highway systems. Forest highways are important to the Federal Government and to the residents of the States, counties, and local communities within and adjacent to the National forests. They carry most of the transcontinental traffic across the Rocky Mountain area of the West and a considerable amount of the interstate traffic over the lesser mountainous barriers in other areas.

While cooperative efforts of the States, counties, and the Federal Government have resulted in progressive improvements of forest highways, a recent survey of highway needs disclosed great need for improvements on the forest highway system to meet the requirements of the increased traffic moving at faster speeds and with heavier loads.

During the year the Bureau completed improvements on 398 miles of forest highways at a cost of $18,085,768, of which $17,171,639 were Federal funds. Table 15 of the appendix indicates these completions and reports figures for projects programed, authorized, and under construction at the close of the year. Some typical forest highway improvements are described in the following paragraphs.

Williams–Grand Canyon highway.—The main approach to Grand Canyon National Park in Arizona is a 52-mile forest highway connecting with U. S. 66. Reconstruction of the route to modern standards, begun in 1946 and interrupted briefly during the Korean emergency, was completed in 1955. Forest highway funds in the amount of $1,943,020 financed 39 miles, and National park road funds in the amount of $813,000 financed the remaining 13 miles within the forest as a park approach road. Traffic averages 1,500 vehicles per day with summer season counts of 2,500 vehicles.

Huntington Lake highway.—A forest highway serves the Huntington Lake area of the Sierra Nevada range east of Fresno, Calif. Construction of 16.5 miles on new location through rugged terrain from Shaver Lake to Huntington Lake was initiated in 1948. In addition to providing access from Fresno and the Central Valley to the attractive Huntington Lake recreation area, the road will open an important timber area to production and will serve large hydroelectric installations on the headwaters of the San Joaquin River. Grading was completed and paving begun, with completion scheduled for the fall of 1955. The total estimated construction cost was approximately $2,814,000.

South St. Vrain highway.—A Colorado forest highway extends from Lyons to Estes Park, a distance of 37 miles. It provides a link in Colorado State Highway Route 7 and is considered the most scenic approach to Rocky Mountain National Park from Denver. Improvement of the route was started during the fiscal year. The first 4.5 miles of construction was sufficiently advanced to permit use by the heavy summer traffic. This route provides year-round intercommunity service and seasonal access to Rocky Mountain National Park. With increasing winter recreational development at the park and along the route, it is anticipated that traffic will steadily increase.

Kenai River bridge at Schooner's Bend, Alaska.—Completion in June 1955 of a bridge over the Kenai River, consisting of four 70-foot prestressed-concrete spans with a 24-foot roadway, removed an old bottleneck on the Kenai River forest highway. It supersedes an old housed timber truss bridge which was both narrow and of uncertain load-carrying capacity. The new bridge is unique in



The Willow Creek Pass forest highway in Colorado.

several respects. The entire superstructure, including girders, diaphragms, deck, and curbs was precast at Portland, Oreg., and then shipped to Seward, Alaska, for hauling to the job site. A saving of $99,000 was realized over a previously designed 190-foot through steel truss with a 40-foot rolled beam approach span at each end.

National park highways, park approach roads, and parkways

Funds for the construction and improvement of highways within or approaching National parks and monuments, and for parkways specifically designated by legislation, are appropriated to the Department of the Interior, and are administered in conformity with regulations jointly approved by the Secretary of the Interior and the Secretary of Commerce. The Bureau of Public Roads collaborates with the National Park Service in establishing road systems and developing annual construction programs, and its engineers make surveys, prepare plans, and supervise construction of the projects on the major roads.

During the year improvements on 135 miles of park highways and parkways were completed. At the end of the year 201 miles of improvements were under construction. Typical improvements are described in the following paragraphs.

Colonial Parkway.—The Colonial Parkway, extending from Yorktown Battlefield through Williamsburg to Jamestown Island, Va., will have a length of 23 miles when completed. The Yorktown–Williamsburg section was constructed about 20 years ago. The Williamsburg–Jamestown section, together with terminal facilities at Yorktown, was under construction, with completion of the parkway scheduled prior to the celebration in 1957 of the 350th anniversary of the founding of Jamestown.

Everglades National Park.—Construction was initiated on the principal park road involved in the development of the Everglades National Park in Florida. Work was started at Flamingo, at the southern tip of the park, and will progress northerly about 38 miles to the park entrance at Homestead. It is estimated that the total cost of construction will approximate $5 million.

Natchez Trace Parkway.—Thirty-four miles of bituminous surfacing were opened to traffic on the Natchez Trace Parkway. This section extends from Alabama State Route 2 northwest of Florence to U. S. 64 east of Waynesboro, Tenn. A railroad overpass near Tupelo, Miss., was also completed. Of the

proposed 450 miles of parkway from Natchez to Nashville, 98 miles were open to traffic in Alabama, Mississippi, and Tennessee.

Blue Ridge Parkway.—While the total length of the Blue Ridge Parkway open to traffic in Virginia and North Carolina remains at 323 miles, considerable work was under way during the year. A grade-separation structure at Tuggles Gap in Virginia was nearing completion with only some approach work remaining. An 11-mile section west of Asheville was under contract. Also in progress at the end of the year were the grading and bridge structures to complete the 10-mile gap adjacent to and north of the James River. The James River bridge was scheduled for the 1957 program. Its completion will close the only gap remaining between Shenandoah National Park and U. S. 460 near Roanoke, Va., a distance of 108 miles.

Western parks and monuments.—While relatively small mileage was completed in the National parks of the Western States, considerable work was under way. Some 68 miles, representing an expenditure of $1,994,000, were improved in Yellowstone, Grand Teton, Rocky Mountain, and Zion-Bryce Canyon National Parks and in the Badlands National Monument. Construction of the 29-mile Zion-Bryce Canyon National Park approach road was completed. The route is an important link in the system of highways serving the National parks and monuments in southern Utah and northern Arizona.

Forest development roads and access roads for spruce-bark beetle control

In cooperation with the Forest Service, the Bureau, when requested, makes surveys, prepares plans, and supervises construction within the National forests of roads of importance in the protection, administration, and integration of the forests. The Bureau has also provided engineers for location and construction of access roads in the spruce-bark beetle control program. During the year, 238 miles of forest development roads and beetle-control roads were completed at a cost of $6,565,761. At the end of the year a total of 221 miles were under contract at an estimated cost of $11,287,000.

Access roads to defense establishments

Legislation of 1950 and 1952, as amended, authorized $95 million for access roads to reservations of the Armed Forces, to defense industries, and to sources of raw materials.

During the fiscal year no new appropriations were made under this legislation. However, the Atomic Energy Commission transferred $2.5 million to the Bureau for the construction and improvement of access roads to sources of uranium ore. The Department of Defense also transferred $13.5 million for access roads to military reservations and defense industries. These funds, with the $42 million previously appropriated under legislative authority of 1950 and 1952 and the $9,991,000 previously transferred by the Atomic Energy Commission, increased the total funds appropriated for access roads since the beginning of the Korean emergency to $67,991,000.

After the termination of the Korean emergency most military installations were operated on a permanent basis. Traffic generated on access roads serving such installations has been continuing traffic from which the State derives highway-user revenues at the same rate per vehicle-mile as it does from other traffic. For this reason, access-road funds were not generally expended on highways included in the Federal-aid systems, nor on other heavily traveled roads. An exception was made where expansion of a defense installation area necessitated closure of an existing Federal-aid highway.

During the year 13 projects serving uranium producing areas were financed at a total estimated cost of $2,294,161, of which $1,759,200 was transferred by the

Atomic Energy Commission. At the end of the fiscal year an additional 22 projects, estimated to cost $3,861,505 and requiring $3,794,742 of access-road funds, had been referred to the Atomic Energy Commission. Five other proposed improvements were being evaluated by the Bureau.

During the same period 56 projects serving reservations of the Armed Forces and defense installations were completely financed at a total estimated cost of $15,815,891, with $12,916,888 financed with funds transferred by the Department of Defense. Preliminary engineering on 13 additional projects had also been financed. Twenty-one other projects having a total estimated cost of $3,174,179 and requiring $3,014,049 of access-road funds had either been certified as important to the National defense or had been referred to the Department of Defense for certification. At the end of the year there were 49 projects being evaluated by the Bureau.

Construction in Alaska

Activity has continued on construction of specific highway projects in and adjacent to the Tongass National Forest in Alaska to serve traffic generated by the growth of a large wood-pulp industry. During the year, 6.8 miles were completed at a cost of approximately $2,496,142. At the end of the year, 4.4 miles were under contract for approximately $675,000.

Bureau of Land Management roads

The Bureau of Public Roads continued cooperation with the Bureau of Land Management of the Department of Interior in its program of road construction in Oregon to salvage spruce timber being attacked by beetles and to provide access to the area for subsequent logging operations.

During the year approximately $170,000 was expended on a bridge and 11 miles of road. At the end of the year 102 miles were under contract for work estimated to cost approximately $5,760,000.

Indian reservation roads

The Bureau of Public Roads continues, under agreement with the Bureau of Indian Affairs, to provide general supervision for the programing, designing, and construction of roads and bridges in each Indian reservation. At the end of the fiscal year, 301 miles of Indian reservation roads were under construction at a cost of approximately $3,989,000.

Improvement of Highway Design

In the interest of improving highway design, the Bureau cooperated with the States in financing several projects involving experimental features. Similar experimental projects were undertaken in various sections of the country in order to obtain results on a national basis.

Some of the projects related to the spacing of joints and use of a circular saw to produce transverse and longitudinal joints in concrete pavements. The sawed joint was liked by contractors since it permitted more efficient use of equipment. The riding qualities of pavement are also greatly improved when the sawed joint is used.

Experimental work was also done in the use of metal reinforcement such as wire mesh, and the use of rubber additive, in the bituminous resurfacing of existing concrete pavements in need of rehabilitation.

Bridge Design

The Bureau participated with the State highway departments in the design and construction of a number of outstanding bridges, including the twin double-leaf bascule bridge over the South Branch of the Chicago River on the Congress

Street Expressway and a similar structure over the North Branch of the Chicago River on the Northwest Expressway in Chicago. Both of these bridges have 6 lanes. Other notable structures were on the Horace Harding and Major Deegan Expressways in New York, the John C. Lodge Expressway in Detroit, the Toledo Expressway in Ohio, the Bay Shore Expressway near San Francisco, the Lake Pontchartrain Expressway in New Orleans, and the Schuylkill Expressway in Philadelphia.

Revision and enlargement of the publication *Standard Plans for Highway Bridge Superstructures*, was undertaken. In cooperation with the timber industry, plans were prepared for five types of timber bridges. New standard plans were also prepared for a precast reinforced concrete bridge and for two prestressed concrete bridges for inclusion in the new book.

Use of welding in steel bridge construction has increased since publication in 1954 by the American Society for Testing Materials of a new specification for structural steel for welding. This steel has received widespread recognition and approval for bridge construction. During the year, several welded girder bridges were built with spans as great as 240 feet. The Bureau assisted the American Welding Society in bringing out a new edition of the Society's bridge specifications which contemplate use of the new welding steel. These specifications were to be published and will undoubtedly encourage engineers to take greater advantage of savings in steel weight in much of the steel bridge construction.

In Federal-aid highway improvement the headquarters office of the Bureau reviews preliminary layouts for major structures—those costing over $250,000. Over 400 such layouts, for jobs costing up to several million dollars, were reviewed, commented upon, and approved.

Use of prestressed concrete in bridge construction continued to grow in favor because in many situations it permits large savings in materials and cost. In response to a demand for a specification covering this new type of construction, the Bureau published *Criteria for Prestressed Concrete Bridges*. This was the only such criteria for prestressed concrete published in the United States.

The Bureau encourages research in structural problems relating to bridges and cooperates with the State highway departments, universities, and other research organizations in these investigations. Projects were under way at Cornell University, Lehigh University, University of Illinois, University of Washington, Texas A. & M. College, Pennsylvania State University, and Mellon Institute of Industrial Research.

The Bureau cooperated with the Transportation Corps of the Department of the Army in studying the effect of certain heavy military vehicles on highway bridges designed according to current specifications. The vehicles exceeded legal widths and were assumed to travel in the center of the bridge roadway. Stress analyses showed that modern bridges will not suffer serious damage under occasional use by vehicles of the type considered. This did not hold true for spans less than 40 feet long, however, and appropriate modification will be made in designs for short spans on the Interstate system.

Use of Aerial Surveys

Expanded highway construction programs and the shortage of engineers have forced administrative officers to use all available means to increase the work productivity of their staffs. One means is the use of aerial surveys. The Bureau has assumed the initiative in applying this important tool in highway location and has cooperated with the States in the dissemination of procedures and in training engineers. Three schools of instruction attended by 85 engineers were conducted during the year. Short intensive courses were given to engineers from Iran, the Philippines, Bolivia, and Uruguay, 17 junior engineers of the Bureau, and 2 engineers of the United States Corps of Engineers.

Expanded use of aerial surveys created a demand for detailed specifications under which commercial photogrammetric engineering firms may submit comparable bids for the furnishing of aerial photographs and topographic maps of sufficiently large scale for making reconnaissance surveys, as well as for use in the more advanced stages of route comparison, preliminary survey, and design. Initiative in organizing a committee to prepare the needed specifications originated within the Bureau. Initial drafts of the specifications prepared by the committee members were correlated and edited and steps taken toward approval and publication.

The Bureau cooperated with the States and other governmental agencies in making reconnaissance surveys by studying existing aerial photographs for specific projects in 13 States, the District of Columbia, Costa Rica, Nicaragua, Panama, Liberia, and the Philippines.

A program of cooperation between the United States Forest Service and the Bureau was agreed upon for the expansion and improvement of aerial survey and photogrammetric methods to be used in the location and design of forest highways and development roads.

It is believed that photogrammetric and aerial survey methods will, in the very near future, become an indispensable part of every large highway engineering organization.

Joint Planning of Highways and Airports

Close cooperation in coordinating the planning of highway and airway facilities existed throughout the year.

The Civil Aeronautics Administration has of necessity limited its cooperation to civilian airports improved with Federal funds. Elsewhere State and local aeronautical administrative bodies cooperated on mutual airway and highway problems in an excellent manner.

There were a limited number of runway extensions and other improvements to civilian airports that affected highways. However, no inadequate or unsafe clearances between the two transportation facilities were created. In many instances existing deficiencies were corrected

Adoption of heavier and faster aircraft by the Armed Forces necessitated the extension of runways at many military installations. Careful planning was necessary to attain adequate and safe operational facilities for aviation, without causing undue inconvenience or hazard to highway traffic or excessive expenditure of public funds.

National Civil Defense Program Assistance

Under the powers granted the Federal Civil Defense Administration, certain responsibilities were delegated to the Secretary of Commerce who redelegated these responsibilities to the Bureau of Public Roads. Under authority of this redelegation the Bureau is to:

1. Provide advice and guidance to State highway departments in the designation of State civil defense emergency highway routes,
2. Coordinate interstate and State designated civil defense highway systems to assure uniformity of designation for civil defense emergency purposes,
3. Plan a national program, develop technical guidance for States, and direct Federal activities concerning emergency clearance and restoration of highways, streets, and bridges in damaged areas, and
4. Provide technical guidance to States concerning highway traffic control problems which may be created during a civil defense emergency.

Repair of Flood-Damaged Roads

For many years it has been the policy of the Federal Government to aid the States in the repair or reconstruction of highways and bridges damaged or destroyed by floods and other disasters of extraordinary character and extent. Such aid is available under an authorization permitting the use of available emergency funds without waiting for legislative action following each disaster. Legislation of 1952 provides a continuing authorization of not to exceed $10 million annually for this purpose.

Allocations of emergency funds totaling $1,644,150 were made during the fiscal year to 4 States for rehabilitation work estimated to cost $3,718,300. Amounts were as follows: Iowa, $523,900; Texas, $907,500; New Hampshire, $192,500; and New Mexico, $20,250.

During March and April 1955 severe floods occurred in Alabama and Mississippi. During the same months disastrous eruptions and lava flows from Mauna Loa and Kilauea volcanoes on the Island of Hawaii destroyed many sections of highway. The two States and the Territory of Hawaii have indicated they will request allocations of emergency funds to aid them in the repair of damaged or destroyed roads and bridges included in the Federal-aid systems.

Foreign Activities

Since the end of World War II the Bureau has responded to numerous requests for assistance in handling foreign highway projects from other Federal agencies. Foreign operations of the Bureau are coordinated and directed by a foreign projects section, which acts as liaison office with the Department of State, the International Cooperation Administration (created at the end of the fiscal year—its predecessors were the Foreign Operations Administration, the Technical Cooperation Administration, and the Economic Cooperation Administration), the International Bank for Reconstruction and Development, and the Export-Import Bank. The section supplies information to contractors, consultants, manufacturers, bonding companies, private individuals, foreign government offices, and other agencies interested in activities in foreign countries.

Technical direction of the overseas projects is supplied or arranged for by this section. One of its major activities is recruitment of technicians, processing them through the necessary clearances and indoctrination, and getting them to the project and back upon completion of a tour.

Training of foreign engineers

During the year the Bureau directed an average of over 30 man-months of training each month for individuals sponsored by the Foreign Operations Administration. In addition, training programs were arranged for 3 man-months of training for engineers sponsored by the United Nations. A large number of casual visitors were assisted for short periods, both in Washington and in the States. Special programs were arranged for groups of engineers including a 6-week program for 9 engineers from Yugoslavia who studied highway construction and maintenance practice, and a 4-week program for 26 highway and public works officials from 13 Latin American countries who studied administration, organization, and financing of highway improvement programs with special emphasis on farm-to-market roads.

The Bureau was assisted in carrying out these training programs by wholehearted cooperation of the State highway departments, county and city highway departments, and numerous equipment companies and other organizations. At the close of the year the Bureau was directing programs for 41 trainees from 14 countries, exclusive of the above-mentioned officials from Latin America.

The Inter-American Highway

Since 1930 the United States, through the Bureau of Public Roads, has been assisting the Republics of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama in the construction of the Inter-American Highway, which is that section of the Pan American Highway from Nuevo Laredo on our Mexican border, to Panama City at the Pacific terminal of the Panama Canal, a distance of about 3,200 miles. Connecting highways from El Paso and Nogales, Tex., to Mexico City now afford more direct routes from the western United States.

The section of the highway in Mexico has been financed and constructed entirely by Mexico.

In June 1955, 95 percent of the Inter-American Highway was passable in all kinds of weather by motor vehicles, but uninterrupted land travel via the Inter-American Highway to Panama City was still an impossibility. Throughout its length of about 1,600 miles in Mexico the highway is open at all times and practically all of it is paved. In Guatemala, starting at the Mexican border, there was an impassable gap of 25 miles which was under construction. Beyond this gap, the highway was passable under all conditions as far as San Isidro, Costa Rica, a distance of about 1,100 miles. In this distance there were many sections on which considerable construction will have to be done to bring the highway up to ordinary modern standards for a 2-lane road, but the route was open and passable.

Beginning at San Isidro, Costa Rica, a formidable impassable section of the route extended for about 150 miles through rough and undeveloped territory to Concepcion, Panama. From Concepcion to Panama City, a distance of 315 miles, the highway was passable at all times but this was another section where much work will have to be done to bring the highway up to ordinary modern standards for a 2-lane road.

During the fiscal year the following was accomplished:

Congress appropriated $5,750,000 to continue cooperative work on the Inter-American Highway.

In Guatemala, construction of a 7-mile section of the 25-mile impassable gap adjacent to the Mexican border was begun by an American contractor. Good progress was made toward the completion of surveys and plans for sections of the highway soon to be placed under construction.

In El Salvador, work continued on the surfacing of the only remaining part of the highway not paved. This 21-mile section has been passable at all times since 1948.

In Honduras, an agreement was entered into between the United States and Honduras for the resumption of construction on the Inter-American Highway, where work was suspended in 1947. Plans were prepared for a short section of the highway near the Nicaragua border, and it soon is to be constructed.

In Nicaragua, construction continued on 16 structures to replace temporary bridges between the Honduras border and Sebaco in the northern part of the country. Four bridges were placed under construction and two were completed. Construction proceeded steadily on improvement of the section of highway between the Honduras border and Sebaco. In southern Nicaragua, widening of the narrow road between Rivas and the Costa Rica border was begun, and plans were prepared for the 10 bridges on this section.

In Costa Rica, activity since 1951 has been concentrated on opening an all-weather highway in the northern part of the country, to the border of Nicaragua. On May 7, 1955, this hitherto impassable section was officially opened to traffic in ceremonies attended by representatives from the United States as well as Costa Rica, Nicaragua, and other neighboring countries. Some work remains to be done, but automobiles encountered no difficulties in traveling the route. In this section, 6 permanent bridges were completed and work was under way on 10 others. In southern Costa Rica, activity was resumed on the survey and

preparation of plans for the impassable gap between San Isidro and the Panama border.

In Panama, 2 sections of highway totaling 23 miles were completed.

Other Latin American projects

In Guatemala, the Bureau has furnished engineering assistance to the Foreign Operations Administration in connection with the construction and improvement of the Pacific Highway, which extends from Escuintla northwesterly to the Mexican border.

In El Salvador, engineering assistance has continued in connection with studies made by the International Bank for Reconstruction and Development looking toward the improvement and construction of the Pacific Highway, a route roughly paralleling the Inter-American Highway, but near the Pacific Ocean.

In Honduras, a Bureau engineer gave part-time assistance to the Honduras Highway Department in the construction of the 80-mile "Highway of the South" from San Lorenzo, a Pacific port, to Tegucigalpa, the capital.

In Nicaragua, technical assistance in the planning and construction of the National highway system (other than the Inter-American Highway) was continued. Work was financed in part by a loan from the International Bank for Reconstruction and Development.

At the beginning of the fiscal year Congress appropriated $1 million for construction on the Rama Road in Nicaragua in addition to $1 million appropriated the previous fiscal year. Work was begun under contract by an American contractor for construction of about 12 miles of this highway. Surveys were continued and plans prepared in expectation of placing another section of this road under contract when additional funds become available.

In Ecuador, technical aid and assistance was continued in the construction of the 115-mile Manta–Quevedo highway which will connect the new port of Manta with Quito, the capital. The project was financed by the Export-Import Bank and the work was done by an American contractor. The project was about 61 percent completed at the end of the fiscal year.

Activities in Turkey

The program of technical and economic assistance to Turkey, which began in 1947, continued throughout the year. Rapid advance made by Turkish engineers in the many phases of highway organization and management made it possible to reduce the staff of the Bureau from 25 to 15 men. Approximately $45.5 million has been made available to finance the cost of technical services and for procurement of road-building equipment that the country could not obtain with local currency. Turkey has supplied all funds for construction and maintenance work and has also financed the cost of additional equipment obtainable from European countries.

From 1948 through 1955 the Turkish budgets for all purposes of highway expenditure totaled approximately $320 million and accounted for 6 percent of the total government expenditures.

The national highway system consists of 15,250 miles of the 87,350 miles of roads in the country which are passable at least by oxcart. All-weather roads on this system have been extended from zero in 1948 to 13,400 miles. Fairly good highway facilities have become available to all the important sections of the country and each year more and more of the areas once isolated become a part of the community as a whole. The economy of Turkey is basically agricultural and movement of farm products has increased tremendously. Construction of new roads and improvement of existing ones have brought about a complete change in the economy since 1948. Formerly, areas well adapted for certain crops could not be fully utilized because any surplus over the local need could not be moved

to locations where such products were in demand. Movement of cereal crops has become nationwide and all areas can now be reached by highways. Travel time and the costs of moving produce and persons has materially decreased due to the improvement of road surfaces, grades, and alinement.

Activities in Ethiopia

In February 1955 the Imperial Highway Authority of Ethiopia celebrated its fourth birthday. Arrangements were completed for the Bureau of Public Roads to continue in responsible charge of the management for another 2 years. Activities are to be confined to the original 3,100-mile primary system, including 550 miles of Federal roads in Eritrea. Financial support, including the cost of the Bureau's missions, will be furnished entirely by the Ethiopian Government with an appropriation equivalent to $8 million. This makes a total of approximately $21.2 million supplied by Ethiopia to supplement the original $5 million loan from the International Bank for Reconstruction and Development. The Bureau staff was reduced from a previous level of about 40 to a total of 18 engineers, construction superintendents, equipment specialists, and administrative personnel. No United States funds have been involved in this program.

More than 90 percent of the 3,100-mile system had been opened to year-round travel at reasonable speeds and reduced transport costs. Major effort during the next 2 years is to be directed toward improved maintenance organization and traffic service.

The economic value of an improved highway transportation system, although limited in extent, was demonstrated by the fact that an average annual expenditure of $1.1 million for reconstruction and maintenance on the 535-mile Addis Ababa–Assab road, with resultant lowering of freight rates by both highway and competing railroad, brought about an annual saving of $1.6 million in the transportation of goods for export and import between the capital city and the ports of Assab and Djibouti.

The Ethiopian authorities and the Bureau management were actively engaged in making studies, establishing priorities, and developing a program for further extension of the primary network of highways, looking toward the establishment of a complete transportation system between farm, market, city, and seaport. This rather ambitious program will substitute fast truck transport for the donkeys or the human transport that now carry coffee, grain, hides, fiber, and other produce from farms to regional market centers or loading points along the present limited highway network.

Activities in the Philippines

The Bureau has had a division operating in the Philippines since 1946. In the beginning that division was charged with effecting the restoration of war-damaged roads and bridges under the Philippine Rehabilitation Act of 1946. When the rehabilitation work was completed in 1952 the Bureau was requested by the Mutual Security Agency (now the International Cooperation Administration) to stay on as consultant to the Philippine Government on a program of highway development and improvement.

The work of the year had three broad objectives: Establishment of a strong and efficient highway department, assistance to the government in effecting a highway development program aimed at opening vast areas of fertile territory in Mindanao for settlement, and promoting the adoption of modern mechanized methods for greater economy and efficiency in highway construction and maintenance.

The first objective was achieved during the year with establishment of the Bureau of Public Highways as an independent bureau within the Philippine Department of Public Works and Communications. While some of the field

offices were not yet fully constituted, the new Bureau of Public Highways compared quite favorably with the average State highway department.

The second phase of the work continued satisfactorily. Sixty miles of development roads were completed and work was under way on an additional 220 miles. Even though none of the four major routes is yet completed, thousands of new farmsteads are being established in hitherto virgin territory, just as rapidly as the advancing road work will permit access to the areas.

Great strides were taken in the mechanization of highway operations. During the year the United States provided some $3,740,000 for the purchase of new equipment to supplement the $13,237,629 worth already purchased and in use. The Philippine Government provided the equivalent of $2 million in Philippine funds for additional equipment purchases. The benefits of mechanization have been evidenced by a decided improvement in the quality of work and marked increases in the economy of construction.

Activities in Liberia

The Bureau, as a participant in the program of the Foreign Operations Administration, continued to assist and advise the Liberian Government in highway construction and planning and in the organization of a division of highways. The Bureau assigned a district engineer to Liberia in 1951. An organization for highway improvement is slowly being developed within the Department of Public Works and Utilities of the Liberian Government. This division was staffed partly by Liberians and partly by nationals of other African and European countries. During the year there were 5 Bureau engineers and 3 equipment specialists in Liberia.

Construction was financed by an Export-Import Bank loan of $5 million and Liberian funds approximating $1 million. Contracts were awarded during the year for 6 projects to cost $2¼ million. This completed commitment of more than 90 percent of the $5 million. Five bids were received on 3 of the projects and 4 were received on the other 3. This was a pleasing result of efforts made to introduce the competitive contract system in a country where it has never heretofore been used.

Activities in Jordan

The Bureau has assisted the Hashemite Kingdom of Jordan with its highway program since 1952. During the year 4 engineers and 2 equipment specialists gave assistance under an agreement with the Foreign Operations Administration.

The work included highway location and design by a photogrammetric engineer on main east-west and north-south roads that will be constructed under a 5-year program. Other forms of help were supervision of construction of 3 roads totaling 55 miles in length, with emphasis on all-weather surfacing. More than 8,000 displaced persons were employed, doing hand labor as almost no machinery was available.

On-the-job training of Jordanian engineers, foremen, laborers, operators, and machines has been one of the major features of the assistance program. Approximately $1.2 million of equipment is being bought. Part of it arrived near the end of the year and was immediately put to use under supervision of the two equipment specialists.

Activities in Pakistan

Steps toward assisting Pakistan in highway improvement under auspices of the Foreign Operations Administration were taken during the year. A Bureau district engineer arrived in Pakistan to plan and supervise the program and a mate-

rials engineer arrived to familiarize himself with available materials and the problems involved in using them. Recruitment in the United States of a staff of 17 engineers and equipment technicians was begun. Preparation for procurement of equipment and supplies to cost $1,254,000 was made.

It was planned to make highway improvements that will demonstrate the benefits of highway transport and at the same time train nationals of Pakistan in highway engineering.

Other foreign activities

The Bureau responded to numerous requests from the Foreign Operations Administration for assistance in highway matters in foreign countries. Engineers and technicians were detailed on assignments of short duration, where advisory assistance was needed on road conditions, repair or maintenance facilities, or improvement of a highway system.

A Bureau construction superintendent spent 4 months in Nepal assisting in the restoration of flood-damaged roads. The country could not be reached by highway from the outside. Reconnaissance trips for a new highway were made on an elephant because of the large tiger bands roaming the tall grass of the region.

A Bureau engineer spent several months in Korea, advising on the proper approach to the rehabilitation of the war-torn streets of Seoul. An equipment specialist was detailed to assist the Korean Government in setting up and operating equipment repair facilities.

A Bureau engineer spent 3 months examining the damage done by Hurricane Hazel to the secondary roads of Haiti, preparing a plan for rehabilitation, and assisting in starting a number of repair projects.

Engineers from the Philippine division of the Bureau assisted local officials in Cambodia, Viet Nam, and Laos on problems of rebuilding war-damaged roads and in setting up training programs for their highway engineers.

Representatives of Egypt sent to this country were assisted in selecting equipment for highway construction demonstration projects, maintenance of desert roads, and a complete materials laboratory.

Highway Safety

The Bureau continued to participate in the joint effort "to advance the cause of safety on the streets and highways," as required by law. Assistance in the promotion of the official action program was extended to five national organizations, including the President's Committee for Traffic Safety which was provided with headquarters office space, staff, and printing and supplies.

The broad purpose of the President's Committee was to lend the prestige and interest of the President to the attainment of a traffic-safety organization in every community and to promote the effective community application of proved techniques for traffic safety.

To unite existing safety services and facilities in the attainment of these objectives, the Committee established an advisory council of principal executive officers of national organizations with recognized safety programs.

The undertaking of the year which created greatest public interest was the 30-day "safe driving" campaign that culminated in S–D Day in December 1954. The primary purpose of this safety promotion was to focus public attention on the need for year-round safe driving and walking.

In spite of a continuing increase in highway travel, traffic deaths declined 2 percent in the fiscal year. The fatality rate (deaths per 100 million miles) was 5.7 for January to May 1955—the lowest ever recorded for this 5-month period and 7 percent under the previous year's rate for these months.

Administrative studies

Organization and management studies previously begun in Louisiana, Minnesota, and West Virginia were completed, and a similar study in Rhode Island was initiated and completed during the year. All of these studies were carried on in connection with highway-needs studies in those States, in cooperation with the State highway departments.

In cooperation with the Highway Research Board committee on highway organization and administration, a booklet of State highway department organization charts was prepared and published. Under the same sponsorship, fieldwork in 4 of the 6 States to be included in a 6-State study of engineering manpower was completed. The preliminary phases of a study of time-saving methods used in highway engineering departments were accomplished.

A study of the practice of specific dedication of highway-user revenues was started, and information concerning pertinent historical, statutory, and constitutional provisions was gathered. This study will trace the growth and development of the practice in the several States, and will evaluate its usefulness as a fiscal device both in the past and with reference to current highway requirements.

Financial studies

Local road and street finance data again were reported for all States. Also, the States reported receipts, expenditures, and debt information for parking meters, publicly owned parking lots and garages, storm sewers, street cleaning, street lighting, and curbs and gutters.

A historical bulletin covering the highway finance activities of local rural units for the years 1942–51 was completed and approved for publication. Work was continued on an urban street finance bulletin covering the years 1941–51.

A highway finance report of receipts, expenditures, and debt status of all governmental units for highway purposes for the years 1945–54 was prepared and published. A review of developments in highway finance during 1954 was also prepared.

Taxation studies

Study of the problems of highway taxation continued, largely with the cooperation of the committee on highway taxation and finance of the Highway Research Board. Efforts were concentrated primarily upon an analysis and appraisal of the existing methods and bases of taxation for the support of highways, and a study of theories and methods for the equitable allocation of motor-vehicle tax responsibility among vehicles of different types and sizes.

A State-by-State analysis of the variation of highway-user taxes with vehicle size for selected vehicles was completed and reported upon to the Highway Research Board committee. Preliminary investigations leading toward a large-scale study of the taxation of interstate and transstate motor-vehicle operations were continued.

Technical assistance was given toward financial and tax studies in Kentucky, Louisiana, North Dakota, Rhode Island, and Washington. All of these were large-scale, State-sponsored projects involving the allocation of highway tax burdens and the development of adequate revenue structures to support expanded programs. Assistance was also rendered Missouri in a study of the allocation of State highway costs by the incremental method.

Highway cost studies

Annual cost research is concerned with the evaluation of the capital investment in highways, operating costs of the highway plant, and the present costs and future

needs of developing highways and streets to standards consistent with motor-vehicle usage.

Analyses of the service lives of roads of various types were continued. The analyses that have been completed thus far show how long various road surfaces last, their present age, and what is done to them when they are rebuilt. Reports on this subject were published in 1940 and 1946. Analyses of experience in subsequent years were under way.

A procedure was developed that permits evaluating future highway needs by a statistical approach. It is based on the relation between highway investment and traffic growth. Estimates of costs for improving highway systems to adequacy over any selected period can be computed in a much shorter time and by a much smaller staff than has heretofore been possible. In addition, the required annual expenditures can be arrayed on a year-by-year basis, thus facilitating the analysis of alternative financing proposals. A pilot analysis was completed for the West Virginia primary rural road system. Similar work was undertaken for Delaware, Missouri, Texas, and Washington. The procedure was used in providing guides for estimating future highway needs after 1965 for a report to Congress.

Production cost studies

The program of research on methods and costs of building and maintaining roads was continued. Cost studies of secondary road work performed by contract and by State forces on five projects in a southeastern State were summarized for comparative purposes. The preliminary findings show that contract work had certain measurable cost advantages over State force work on the jobs studied.

The field study program of cost of maintenance of selected sections of bituminous roads in western States was completed. Field studies of the cost of maintenance of portland cement concrete roads in midwestern States were started and were to continue for 3 years. Four comprehensive field studies of construction costs of grading and paving work in central and western States were in progress at the end of the year.

Land acquisition, roadside control, highway laws, and terminal facility studies

Research on legal and administrative problems connected with the acquisition of highway right-of-way, protection of the roadside, access control, and the provision of terminal facilities was continued. Much of this work was done in cooperation with State highway departments and national organizations. Assistance to State highway departments and numerous other organizations and individuals continued during the year in these fields.

The Bureau cooperated with the Highway Research Board in a special research project relating to highway laws. Its objective is to assemble data that will be helpful in providing modern legal tools for use in an accelerated program of highway improvement.

Study of methods of reserving land for future highway right-of-way purposes continued. An increasing number of States were interested in this matter, and State legislatures and courts supported this concept to a far greater extent than ever before. Several States, including California and Ohio, used a right-of-way revolving fund to facilitate the purchase of highway right-of-way in advance of physical need.

Research concerning enabling legislation for parking facilities, involving extensive analyses of all existing statutes on this subject, was almost completed by the end of the fiscal year.

Further research on parking provisions contained in zoning ordinances was completed, and a report was published summarizing the extensive data involved. This report indicates that there are now more than 311 municipalities with ordi-

nance provisions relating to the provision of parking space through the zoning mechanism. The zoning device is being used more and more to assist solution of urban transportation difficulties.

Highway Transport Research

Road inventory and mapping

Data of fundamental importance in determining needs and deficiencies of the entire road network and in appraisal of the performance and adequacy of the several highway systems were obtained in a continuing inventory process in 41 States and Hawaii. Work of inventorying highway conditions and business, industrial, and other development along them was done by State highway departments as Federal-aid projects. In 30 States, general highway maps were prepared for 292 counties. Other mapping activities resulting from State planning surveys included the preparation and publication of 15 State general highway maps, 32 State traffic maps, and many other special area maps, and city and county traffic maps.

Traffic volumes and truck weights

Every State developed information concerning the growth in highway traffic. Forty-two States submitted data collected in the summer of 1954 at over 500 stations operated for the past 13 summers to determine trends in loading practices and weights by vehicle types. From these data estimates of truck travel, average carried loads, and ton-mileage of freight transported were computed. Another use of this information was the determination of the effectiveness of State law enforcement and relative conformity with the recommendations of the American Association of State Highway Officials.

During the past fiscal year traffic in rural areas increased at a considerably lower rate than in any year since the surveys started in 1936, exclusive of the war period. Traffic in urban areas increased somewhat faster than it did in the rural areas but the rate of increase was below that of former years. All rural travel increased about 2.9 percent while urban travel increased 3.2 percent.

Discoveries through basic research of the sampling error resulting from variations in the length of traffic count, number of locations, and scheduling of counts led to development of improved techniques. Appraisal of rural traffic-counting methods used in seven States, by means of these new techniques, led to development of more efficient procedures.

Motor-vehicle-use studies

Studies of motor-vehicle use were conducted as another type of investigation useful in estimating highway service of Federal-aid projects. These studies were statewide in scope and were designed to yield information on rural and urban ownership of vehicles, proportion of travel on the various road systems, modes of home-to-work travel, purpose of travel, and frequency and length of trips. Such information has important bearing on the solution of highway planning and financing problems.

At the close of the fiscal year, studies were in progress or were completed in 20 States and Hawaii. Fieldwork was still under way in two States and plans were being made to initiate work in an additional State.

Traffic studies in cities

A resurvey of traffic movement in the Tulsa metropolitan area by the home-interview method was completed during the year. A comparison of the data with that collected in the original study made in 1944 shows substantial changes.

A resurvey of the Washington, D. C., metropolitan area was started and one in the Omaha area was scheduled for an early beginning. A comprehensive

transportation study of the Chicago metropolitan area was also scheduled, using the home-interview technique developed by the Bureau.

Urban highway planning

Continuing analyses were conducted as to the relation between residential and commercial land uses and the daily trips of metropolitan-area residents. The determination of a feasible quantitative measure by which market areas for existing and proposed retail facilities could be established was desired. Data analyzed came largely from home-interview traffic studies in metropolitan areas, particularly from the 1948 Washington, D. C., transportation study.

It was determined that the directional movement of shoppers in urban areas is largely dependent upon the competitive relations of the shopping areas and a method for measuring this movement was developed. In the case of "shopping goods," such as apparel and furniture, it was found that the attraction of a shopping area to a group of shoppers is related directly to the size of the shopping area, in terms of the retail floor space dedicated to the merchandise, and inversely to the square of the distance of travel time. Trips for frequently purchased items, such as food and miscellaneous household supplies, can be forecast on the basis of auto travel time and retail floor space.

Shopping trip patterns for smaller cities were found to be significantly different from those of cities having a population over 150,000. Shoppers in the smaller cities are largely dependent upon downtown stores for both convenience and shopping goods, while in the larger cities a more dispersed pattern of trips was noted.

Toll-road studies

The Bureau continued its studies of traffic using toll roads in order to establish a sound basis for estimating the volume and kind of traffic likely to be attracted to a high-type facility. This is of particular importance because of the present emphasis on the completion of the National System of Interstate Highways.

In estimating the probable traffic usage of a proposed facility, the engineer must concern himself with three factors: Diversion, generation, and long-time growth. To do this successfully, data from both ordinary and high-type facilities are needed.

Studies of controlled-access, nontoll highways have been made in urban areas but not in strictly rural areas. There are few controlled-access free roads of some length and these have been opened to traffic only recently. The toll roads, built to standards approximating those for the Interstate system, offer good opportunities for study notwithstanding the deterring effect of toll charges. However, the effect must be evaluated in applying the results to free roads.

Studies of the Maine and Pennsylvania Turnpikes show that generated traffic (traffic other than that diverted from adjacent roads) ranged from 30 to 40 percent of total traffic. Traffic diversion to the turnpikes was greater for passenger cars than for commercial vehicles, except in mountainous areas. The Maine and Pennsylvania Turnpike studies indicate that time saved by use of a better highway facility is a good indicator of traffic that may be diverted from other highways.

Parking facilities

Urban highway planners often wish to coordinate parking facilities with highway development in order that highway facilities may function properly. The Bureau is concerned with developing facts showing the relation between terminal facilities and movement of traffic, particularly with respect to Federal-aid highway programs in cities. Parking studies of the type described in previous reports were conducted in 21 cities, bringing the total to 115 cities in 36 States.

To determine what has been done to reduce parking congestion, reinventories of parking space supply were made during the year in 37 cities in which studies

had been made from 5 to 9 years earlier. The smaller cities consistently showed losses of about 14 percent in curb space capacity, and cities over a million in population showed losses of as much as 40 percent, reflecting the elimination of parking on important streets to improve flow of traffic. The gain in off-street facilities more than compensated for the losses at the curb. There was a net gain in total parking capacity averaging about 14 percent, but this gain had not kept pace with the still greater increase in demand which accompanied the growth in travel volumes.

During the year a procedure was developed for making a simplified and less expensive type of parking study, appropriate for cities under 15,000 in population. Testing of the procedure was begun in a southern city.

Economic cost of motor-vehicle accidents

The first comprehensive study of the economic cost of motor-vehicle accidents on a statewide basis was launched in cooperation with the Commonwealth of Massachusetts. The first phase of the Massachusetts study—direct cost of accidents to passenger-car owners—was scheduled for completion in 1956. At the end of the year exploratory conferences were being arranged for the purpose of extending the studies to other States.

These studies are designed to determine the total annual cost of motor-vehicle accidents, to evaluate in detail the direct and indirect cost of motor-vehicle accidents to vehicle owners, and to correlate these costs with all pertinent accident characteristics. There is little knowledge of the nature and composition of accident costs and almost a complete lack of accurate statistics for evaluating efficiency of the highway transportation system from the standpoint of losses through accidents. Cost estimates are in scant detail because of incomplete data and they are of little value in engineering work where precise measurements are needed. The accident-cost studies are designed to correct this deficiency by providing comprehensive and accurate information for use by all groups trying to reduce accidents and the economic loss therefrom.

Highway capacity research

The *Highway Capacity Manual*, published in 1949, has been widely used in the design of highways. The factors developed through research have been particularly valuable in planning to relieve congestion on city streets. The demand for additional information on highway capacity prompted a study aimed at enlarging the scope of the sections of the manual dealing with intersections at grade and entrances and exits on expressways. Additional information was sought for one-way streets and for expressways, with a general overall refinement of the procedures for computing capacities as an objective. The collection of basic data was well under way at the end of the year. Twelve cities in 9 States had submitted detailed data for 102 intersections carrying capacity volumes. It was anticipated that cities in nearly all of the 48 States would assist in the study, which was planned in such manner that participation by a large number of cities would obviate the necessity of imposing a heavy burden on any single agency.

Traffic operation on a reversible one-way street with a highly efficient traffic-control system was studied, and the effect of each variable that influenced street capacity was determined. As one part of the study, stop signs were substituted for traffic signals to determine their effect. A report was prepared comparing the efficiency of signals with that of stop signs on cross streets and with stop signs on all streets entering the intersections. The report disclosed that reversible one-way streets are capable of accommodating extremely high vehicular volumes when effective traffic-control measures are properly employed.

The effect that mass-transit vehicles have on the capacity of city streets was investigated. A study having as its objective a determination of the efficiency of trolley coaches in the utilization of street space and the movement of people was

completed. A report was to be prepared combining the results of this study with those of an earlier investigation of the efficiency of streetcar and bus operation as compared to automobiles in the utilization of street space.

Accident experience on controlled-access highways

In the recent refinement of design standards, highway engineers have shown a growing appreciation of the benefits of control of access. To explore the safety advantages attributed to this feature, a study in cooperation with State highway departments has been conducted over the past few years. More than 2,000 miles of streets and highways were classified as to their access-control characteristics, the gross records including over 36½ billion vehicle-miles of travel and approximately 108,000 accidents, in which more than 2,500 persons were killed.

The findings clearly demonstrate the superior safety of expressways with full control of access—that is, where roadways for opposite-direction travel are separated by a median, crossing roadways are separated at intersections, and access is permitted only at selected places. The number of fatalities per 100 million vehicle-miles of travel on facilities where access was fully controlled averaged about one-third of the number for ordinary highways, and the rate of total accidents averaged less than half. Streets and highways with only partial control of access had high fatality rates, averaging even higher than did facilities with no control of access. Further examination of this finding will be made by obtaining data on a larger mileage of highways.

The excellent safety records of highways with full control of access are expected to have continuing value in justifying the high design standards planned for the Interstate system.

Studies of paved shoulders

The practice of paving highway shoulders in an effort to decrease maintenance costs and to improve the utility of the shoulder for emergency use of vehicles has shown a marked increase in the past few years. The western and southwestern States in particular have added considerable mileage of this type of construction on their primary highway systems. Methods and materials of construction vary widely. Sometimes the shoulder surfacing material or textural treatment differs from that of the traveled lanes. In other instances the surface is of uniform texture and material for the entire roadway width including the shoulders. Many of the 2-lane rural roads of this type differ very little in appearance from 4-lane undivided roads with no shoulders.

The gain in popularity of this type of construction has given rise to a number of questions relating to the regulation and control of traffic. How should the pavement be marked so that the highway will carry its traffic load with least congestion, lowest maintenance cost, and highest degree of safety? What messages on regulatory signs will best assure safe and efficient use of the highway? Does this type of construction provide a safer and more economical highway than the conventional 2-lane road with wide but unsurfaced shoulders? These are typical of the questions troubling highway officials in many States.

As an initial step toward appraisal of the merits of rural roads with paved shoulders, a study of driver behavior was undertaken cooperatively by several of the State highway departments and the Bureau. Measurements were obtained of the speeds, transverse positions, and spacings between vehicles on selected sections of highways in Arizona, California, New Mexico, and Texas. Record was made of the manner in which passing maneuvers were performed—whether they were made on the right or left side of the passed vehicle, whether the passing vehicle crossed the centerline or the passed vehicle used the shoulder, and whether passings were performed in the face of oncoming traffic. At the end of the year the data were being analyzed, and studies were continued in several other western States including Colorado, Idaho, Oregon, Utah, and Washington.

Sign legibility

Signs with white reflectorized letters on a dark background have a halo around the letters which interferes with legibility under certain conditions. To acquire new knowledge of this phenomenon and of the effects of varying spacing between individual letters, a study of the field legibility of signs was initiated. Six test words were chosen, using three different letter styles and two types of reflectorization. Legibility distances were determined for these words displayed in their normal length and in lengths 20, 40, and 60 percent greater than normal. Thirty-six observers were used and, to add realism, all observations were made by the subjects as they were driving a vehicle at 30 miles per hour toward the sign, which was constructed so that two words could be displayed simultaneously.

Partial analyses of the data indicate that increases in inter-letter spacing had a definitely favorable effect on the distances that the signs could be read. In general, the gains in legibility were smaller as the word length was increased beyond 20 percent of normal. Complementary considerations of legibility increases that can be obtained with greater letter height were to be evaluated, so that guides will be available for selection of an optimum alphabet height, width, and spacing for given legibility requirements.

Brake research

In 1954 the Bureau published a comprehensive report on motor-vehicle brake performance, based on the results of tests conducted from November 1948 through September 1951. One phase of the study concerned tests on passenger cars and commercial vehicles in the general traffic stream at test locations in Maryland, Michigan, and California. Repetition of the tests was begun at the same three locations in order to maintain a continuing record of the general level of brake performance.

The vehicles were selected at random from the general traffic, weighed and described, and then subjected to emergency stops from 20 miles per hour. Stopping distances were measured with special apparatus. The results of this work will make it possible to examine, for possible revision, present highway standards and regulatory measures in light of current levels of brake performance, and to promote highway safety by pointing out any deficiencies in brake performance.

Tire pressure study

The inflation pressures of tires on heavy vehicles as they run "hot" in service were investigated for use in planning the American Association of State Highway Officials road test project. These data will be needed in selecting the size and operating pressures of tires on test vehicles. The study was conducted in 37 States in conjunction with the regular 1954 summer survey of vehicle weights. Tire pressure and corresponding wheel loads were measured on the right side of about 8,000 vehicles with some 40,000 tires.

The results will make it possible to determine, for current practice, the relation between wheel load and inflation pressure for a given tire size, and the frequency and range of inflation pressures for a particular tire size.

Passenger-car operating characteristics

The Bureau made extensive use of instruments developed by the committee on vehicle characteristics of the Highway Research Board to observe operating characteristics of a typical 1951 model passenger car. It was operated by the same test driver about 28,000 miles on five distinct studies during 1951 and 1952. These studies dealt with operations over a high-speed expressway and over the parallel major highway. The results were analyzed and published during the year.

It was found that use of the expressways saved considerable time but the higher speed of travel increased gasoline consumption per mile. However, in 4 of the 5

cases studied the shorter length of the expressway made it possible to travel either the expressway or the parallel highway with about the same total consumption of gasoline.

Useful information of an incidental nature was developed from this study. The variation of fuel consumption with speed and gradient and the variation of fuel consumption with rise and fall for various attempted speeds were determined. These relations are used in the report to evaluate the effect of different methods of reducing gradient and of methods for estimating the fuel consumed on a given section of highway. Other data reported show the distance and fuel required to accelerate from 0 to 70 miles per hour on various degrees of grade.

Economics of motor-vehicle size and weight

Determination of the overall cost of highway freight transportation by various types of vehicles is essential for rational determination of truck size and weight limits. Costs include those of owning, maintaining, and operating trucking equipment, plus such costs of constructing and maintaining highway facilities as may properly be assigned to freight vehicles. The objective is the lowest overall cost of highway transportation per unit of freight transported.

Field work of interviewing motor carriers for cost and operational data was under way in 10 States at the end of June, and the work was completed or suspended in 8 additional States. It was expected that work of this nature will be under way in 8 more States within 6 months.

This program of research was developed in collaboration with the Highway Research Board committee on economics of motor-vehicle size and weight.

Hydraulic Research

It has become increasingly evident that damage to highways and highway structures caused by floods can be alleviated in considerable measure by anticipating the magnitude, river stage, and frequency of floods and designing roadway embankments and bridge and culvert openings to pass such floods safely. The hydraulic research program of the Bureau during the past year has been aimed in large measure at analyzing the available data on floods and in supervising laboratory experiments on various types of bridges and culverts to learn how they actually perform during floods. Use was made of facilities of other agencies uniquely qualified to carry out certain phases of the research under the supervision of specialists from the Bureau.

An investigation by the Weather Bureau has indicated that rainfall records could be used to improve greatly the reliability of estimates of probable flood magnitudes. Graphical correlations of rainfall and runoff together with streamflow hydrographs developed for flood forecasting proved to be useful in projecting flood records back into the past. Thus it was possible to build up a reasonably good record of floods going back as far as 1900 even though no measurement of the floods themselves had been made until some 20 or 30 years later. The technique requires further checking, which will be done under a cooperative agreement with the Weather Bureau.

In certain localities rainfall gages are sparsely distributed yet variations in rainfall are known to be large. Stanford University has been investigating for the Bureau the correlation of rainfall intensity with topographic factors, this work being confined to a limited area in California.

During the year an investigation of the extent to which contraction of the normal cross-section of a stream by a bridge modifies the profile of the water surface upstream and downstream from the bridge was initiated as a cooperative research project at the hydraulic laboratory of Colorado Agricultural and Mechanical College at Fort Collins. Small-scale model studies indicated that the increase in the water-surface elevation (referred to as "backwater") is related most impor-

tantly to the degree of contraction of the total stream section and only to a minor degree to differences in the exact shape of the abutments or piers. This finding, if sustained by additional tests initiated and covering a wide range of channel shape, roughness, and alinement, should enable a simple computation of the required waterway area as limited by the tolerable backwater at a given site. The results of earlier investigations by other agencies have made the problem appear to be immensely complicated.

The design of the small drainage structure—an important matter because of the amount of money spent annually for thousands of culverts—has been subjected to very thorough investigation by the hydraulic laboratory of the Bureau of Standards under a cooperative agreement with the Bureau. This research has clarified questions arising from conflicting reports by other investigators on the actual operation of culverts of designs commonly used. A report on the work was deferred pending completion of a few tests on full-size concrete and corrugated-metal-pipe culverts in order to verify the results obtained with the small-scale models.

Recorded measurements of scour at the nose of a bridge pier on the Skunk River in Iowa have agreed remarkably well with small-scale model measurements obtained by the Iowa Institute of Hydraulic Research for the Bureau and the Iowa State Highway Commission. Similar measurements at other more complicated sites are now needed.

The University of Missouri investigated the efficiency of storm drain junctions as a cooperative project financed by the Missouri State Highway Department and the Bureau. Under certain conditions the efficiency was found to be surprisingly low.

Physical Research

Soil studies

A number of investigations dealing with various phases of the study of soils were continued with the cooperation of State or Federal agencies. Production of engineering soil maps for Illinois, Maine, and Rhode Island was continued with the assistance of the respective State highway departments. A similar project for New Jersey was completed. In cooperation with the Soil Conservation Service of the United States Department of Agriculture, tests of samples from 14 counties in 8 States were continued.

Cooperative studies were continued in Indiana and Ohio to determine the effectiveness of subbases composed of granular material or soil-cement mixtures in the control of the pumping of concrete pavement. Observations of the behavior of pavement slabs, moisture-cell readings for units in the subgrade, traffic counts, and truck-weight surveys were made periodically.

An investigation of clay-size constituents in soil materials, limestones, and shales was continued with the analysis of a considerable number of samples of widely different physical properties. In connection with this, a new method for the preparation and treatment of soil-clay specimens for X-ray diffraction analysis was developed. This method is rapid, readily permits the application of several diagnostic treatments to a single specimen, and greatly enhances the clarity and usefulness of X-ray diffraction patterns.

A program of research in cooperation with chemical manufacturing companies for the chemical treatment of soils was continued. The purpose is to find a method of stabilizing structurally poor soils to a sufficient extent to permit their use as base-course materials.

Studies of the suitability of shale, burned shale, chert, and refuse from coal mines for use in base courses and roadway shoulders were continued in cooperation with the Pennsylvania Department of Highways. Progress was made in the correlation of the physical properties and field behavior of these materials. A study

was started to determine if the type and nature of the clay minerals in these materials are related to the behavior of the materials in service.

Bituminous materials and mixtures

The study of rubber in bituminous pavements was continued. A report on the laboratory study of blends of 14 rubber materials and several asphalts was published, and work was done on 3 additional rubbers. A laboratory and field study of rubber latex emulsion in sand-asphalt pavement was initiated jointly with the highway department of the District of Columbia. Experimental sections of pavement for this study were completed and placed under observation and test.

To measure more accurately the quality of asphalt currently produced, with special reference to durability and resistance to hardening, a laboratory and field study was conducted on a number of asphalts supplied by field engineers. The information obtained will be used to develop specification requirements for better control over the quality of the material. Additional asphalts will be tested until the production field is covered.

The study of additives for bituminous materials with special reference to their heat stability was continued. A report on the first heat-resistant additives was published in 1954. New additives became available and these, too, have been examined. A supplementary report on them was being prepared.

Studies to develop more accurate information and to standardize tests of physical properties of bituminous pavements were continued. A portion of this work was conducted under the auspices of the Highway Research Board and in cooperation with nine laboratories representing State highway departments and industrial organizations. In addition, a cooperative investigation with the North Carolina State Highway and Public Works Commission was undertaken to evaluate the reproducibility of immersion-compression test results obtained by several laboratories. Cooperation with a number of State highway departments in correlating laboratory test methods and test results with service performance was continued.

Cement, aggregates, and concrete

Shortage of cement warranted a study of pozzolanic materials that could be used to replace a portion of the cement in concrete. Of available materials, fly ash was considered most promising. This is a waste product from plants burning pulverized coal. A comprehensive series of tests to determine the characteristics of fly ash was completed and a report prepared. The results of this study indicate that fly ashes suitable for use in concrete can be identified by simple and rapid methods of test.

Investigation of the alkali-aggregate reaction in concrete was continued with study of methods of controlling the reaction. Some fly ashes were found quite effective. Preparation of a series of concrete specimens to determine the susceptibility of aggregates to reaction with alkali was completed. It was believed that these concrete specimens will show the properties of coarse aggregates more exactly than mortar specimens prepared with the aggregate crushed to sand size. Other studies of chemical and physical aspects of the alkali-aggregate test were made to improve the dependability of the method.

Study of a proposed major revision of the sulfate soundness test for aggregate was completed. Associated with this was an exploratory inquiry into commercial home freezing units which may be suitable for laboratory use. Modification of such a unit to furnish automatic and rapid freezing and thawing of aggregate should eliminate the need for the sulfate test and assure a more dependable determination of the soundness of aggregates.

Investigation of methods of improving the quality of coarse aggregates which give concrete of low strength was continued. A local aggregate was used and various means of improving its concrete-making properties were tried. These

methods included use of smaller top-size materials, redesign of the concrete proportions, compatibility with different sands, and removal of particles of doubtful quality by means of hand picking or mechanical scrubbing. Concrete specimens were made with each of the prepared materials. Tests of these specimens were begun. A study was to be made of the data obtained before starting similar tests on other aggregates.

A progress report was published on methods of treating concrete to resist the action of calcium chloride used to remove ice. This study was extended to include methods of treating the surface of concrete with silicones. The silicone-treated slabs were not exposed for a long enough period during the first winter to bring out any differences in resistance to the calcium chloride attack, and additional weathering will be required before conclusions can be drawn.

An investigation in cooperation with 12 other laboratories and under the auspices of the Highway Research Board was begun in an appraisal of the 4 American Society for Testing Materials methods of conducting freezing and thawing tests of concrete. The proportions for use in all 13 laboratories were determined and checked by means of trial batches in the Bureau laboratory. Each laboratory then prepared test specimens using locally available materials. The results of these tests are expected to be of considerable value in the appraisal of the suitability of the different methods.

A study of the Kelly ball as a device for measuring the consistency of concrete in the field was made in comparison with the standard slump cone. The advantage of the Kelly ball test is that concrete may be tested in place, eliminating selection or preparation of a sample, and 3 or more Kelly ball tests can be made in less time than is required for 1 slump test.

A spring-actuated impact hammer, the so-called Swiss hammer, was investigated for use as a type of nondestructive test for estimating the strength of concrete. The tests made indicated that the results are relative but with a known unit for comparison it is possible to obtain reliable estimates of the probable strength of concrete in existing structures.

Testing the durability of concrete was continued. Detailed inspections were made of each of the 110 box-type specimens, made with 26 portland cements of variable composition and from different sources, and exposed out-of-doors. Length change and sonic measurements were made on 330 concrete prisms prepared from the same materials as the outdoor specimens. In addition, an inspection was made of full-size experimental pavement slabs in the field, and of concrete specimens prepared with different water-cement ratios exposed at Treat Island, Maine.

Structural design of rigid pavements

In the previous report mention was made of an experimental reinforced concrete pavement constructed on U. S. 40 in Indiana in 1938. The pavement contained sections of various lengths reinforced with various types and amounts of longitudinal reinforcing steel. Primarily, the objective of the research was to develop information regarding the extent to which constructed transverse joints could be reduced through the use of longitudinal steel reinforcement. The research was a cooperative undertaking of the State and the Bureau. The regularly scheduled measurements on this pavement were discontinued after the publication of the 10-year report. However, the results of the investigation were of considerable interest and led a number of State highway departments to construct experimental pavements of similar design in an effort to extend the data to even longer sections. Because of this continuing interest, the State and the Bureau made another complete examination of the pavement in the spring of 1954 after more than 15 years of service, and reported the results.

A program of laboratory tests of the structural performance of doweled joints as used in concrete roads was completed. These tests were made with specially designed machines in which the load-transfer system of the joint was subjected to load and support conditions simulating closely those of concrete pavements in service. Loads comparable to those of heavy trucks were applied many hundreds of thousands of times, the purpose being to find out how such load-transfer systems fail in service. By means of precise instrumentation the relative effectiveness of different designs was determined. Much new and valuable information never before available was obtained on this particular structural design problem.

Previous reports have described an extensive investigation in cooperation with six States which had for its broad purpose the study of the structural effects of various transverse jointing arrangements in concrete pavements. Participants in this research were California, Kentucky, Michigan, Minnesota, Missouri, and Oregon, and in each State nearly identical pavements were constructed. Reports containing the data collected and the observations made during the first 10 years of service life have been received from all of the States. The Bureau has been an active participant in these studies and during the past fiscal year prepared an analysis of the data contained in the State reports. The reports, together with the analysis, were to be published under one cover.

Structural design of nonrigid pavements

There is continuing, widespread interest in improving the methods now used for determining the thickness and other design features for pavements of the so-called flexible or nonrigid type. Much investigational work was under way and the Bureau participated actively in the effort.

The cooperative research on nonrigid pavement sections of several designs at Hybla Valley, Va., was terminated. The Highway Research Board, the Asphalt Institute, and the Bureau had participated in this study. A comprehensive report of the plate-load tests was prepared. A short separate report on certain other aspects of the investigation was in course of preparation.

The Bureau cooperated with Maryland and Virginia in planning and conducting exploratory field studies of the deflection of pavements of the nonrigid type under heavy wheel loads. Assistance in the form of personnel and deflection measuring apparatus was provided by the Bureau in an effort to establish the usefulness of load deflection data for evaluating the load-carrying ability of flexible pavements. The apparatus used was a device developed in connection with the Western Association of State Highway Officials road test by the Bureau representative on that project. Valuable data were obtained and it was anticipated that cooperation with these States would be continued.

The Bureau cooperated with Oklahoma in planning and conducting a study of nonrigid pavements in service. This study included consideration of the type and condition of the subgrade soil, of the pavement components, and of other pertinent factors. In addition to a rating of the structural condition of selected pavements and to the necessary soil studies, both plate-load and vehicle-load deflection tests were to be made at selected locations. Completion of the planned program should enable the State to utilize to the maximum extent research data from the Western Association of State Highway Officials road test and the coming American Association of State Highway Officials road test, through correlations with their own particular conditions.

Road tests

Participation by the Bureau in the Western Association of State Highway Officials road test was essentially concluded during the past fiscal year. The Bureau gave active support to the project and played an important role both in

the conduct of tests and in the preparation of the report of the findings. The report will be published by the Highway Research Board.

Plans were matured for a large-scale field research into the performance of pavements of both the rigid and nonrigid types under controlled traffic. This research, sponsored by the American Association of State Highway Officials, will be directed by the Highway Research Board. Active participation by the Bureau was authorized. The services of personnel of the structural research section and the facilities of the shops organization will be a part of this participation.

Bridges

Preparations were made for continuation of the studies of the structural action of highway bridges under moving vehicular loads, through measurements of strain and deflection at critical points. Tests of this kind in cooperation with the State Highway Department of Oregon were mentioned in last year's report. The relative merits of several methods for measuring deflection were investigated and determined. A simple means was developed for indicating the position of the test vehicle with respect to the point at which measurements of strain or deflection are made.

Studies of the surface characteristics of pavements

Interest continued in the equipment developed by the Bureau for indicating the relative roughness of road surfaces. Several additional States built equipment from plans furnished by the Bureau. The equipment was used on experimental pavements in Indiana at the request of the State, was demonstrated on Long Island, N. Y., at the request of the division office, and has been used on the Baltimore-Washington Parkway to compare various sections. Improvements were made in the electrical system.

The slipperiness of pavements is a matter of concern to State highway departments and many others. During the year a study was begun of the various methods that have been used to measure the relative slipperiness of road surfaces, both in this and foreign countries. It was planned to study certain of these methods experimentally to determine their relative merits. A preliminary design of testing equipment for this purpose was prepared.

Geophysical methods for subsurface exploration

Interest in the application of geophysical methods of subsurface exploration to highway engineering problems continued to increase as its value and simplicity became better known. The earth-resistivity test procedures were demonstrated in Colorado, Maryland, New Mexico, Utah, and Wyoming. Other geophysical work was done in North Carolina and Pennsylvania. Demonstrations and training programs were conducted in Costa Rica, Guatemala, Nicaragua, and Panama preparatory to the introduction of the methods on the work of the Inter-American Highway. Approximately 100 engineers of the Central American Republics were acquainted with the use of the methods through field training and lectures.

Four additional State highway departments acquired or began the construction of earth-resistivity apparatus for use in their subsurface exploration program.

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Table 1.—Summaries of programs approved and work completed in the fiscal year 1955, by class of highway and by fund

	PROGRAMS APPROVED[1]						WORK COMPLETED					
				Railway-highway crossing improvements						Railway-highway crossing improvements		
	Total cost	Federal funds	Miles	Crossings eliminated	Structures reconstructed	Crossings protected	Total cost	Federal funds	Miles	Crossings eliminated	Structures reconstructed	Crossings protected
	BY CLASS OF HIGHWAY						BY CLASS OF HIGHWAY					
Primary-rural, Interstate	$185,572,245	$108,664,393	1,192.4	35	2	2	$153,081,355	$80,656,124	1,224.0	26	3	13
Primary-rural, all other	516,996,159	271,293,460	6,394.0	68	11	146	330,218,548	168,662,029	4,826.1	45	12	74
Secondary-rural	425,428,220	224,839,016	18,208.3	33	1	222	336,425,506	175,754,315	14,692.4	19	7	175
Urban-Interstate	159,068,196	83,964,233	185.2	21	3	1	174,920,383	87,107,318	209.6	50	8	5
Urban, all other	300,051,491	152,428,464	706.7	57	11	30	255,542,410	131,241,187	632.4	76	8	50
Subtotal	1,587,116,311	841,189,566	26,686.6	214	28	401	1,250,188,202	643,420,973	21,584.5	216	38	317
Not classified[2]	35,917,981	32,607,394	764.0				30,304,132	27,809,996	570.9			
Total	1,623,034,292	873,796,960	27,450.6	214	28	401	1,280,492,334	671,230,969	22,155.4	216	38	317
	BY FUND						BY FUND					
Federal-aid:												
Primary	664,491,756	350,024,864	7,167.0	106	21	160	520,961,518	268,170,374	6,190.0	77	18	120
Secondary	423,874,565	218,375,933	17,997.8	34	1	219	328,753,413	168,162,260	14,334.7	21	8	170
Urban	337,375,027	170,942,252	329.1	51	4	15	338,235,313	169,973,152	313.4	109	12	21
Interstate	142,658,285	86,565,803	847.2	20	1	1	34,397,554	17,787,112	259.2	6		
Prewar Federal-aid:												
Primary												
Secondary												
Grade crossing							413,499	331,304				3
Access roads, Act of 1950	18,716,678	15,280,714	345.5	3	1	6	25,899,988	18,247,666	487.2	3		3
Defense Highway Act							1,526,917	749,105				
Subtotal	1,587,116,311	841,189,566	26,686.6	214	28	401	1,250,188,202	643,420,973	21,584.5	216	38	317
National forest highway[3]	13,722,163	11,970,705	449.5				18,085,768	17,171,639	398.1			
Tongass National Forest, Alaska[3]	656,000	656,000	4.4				2,496,142	2,496,142	6.8			
National park and parkway[4]	16,369,500	16,369,500	240.9				6,164,429	6,164,429	135.1			
Public lands	2,362,650	2,211,340	41.2				631,207	545,331	6.0			
Emergency flood relief	2,807,668	1,399,849	28.0				2,926,586	1,432,455	24.9			
Subtotal	35,917,981	32,607,394	764.0				30,304,132	27,809,996	570.9			
Total	1,623,034,292	873,796,960	27,450.6	214	28	401	1,280,492,334	671,230,969	22,155.4	216	38	317

[1] Initial commitment of funds.
[2] Forest, park, public lands, and emergency flood-relief projects.
[3] Includes construction projects only.
[4] Construction supervised by Bureau of Public Roads.

Table 2.—Projects under construction or plans approved on June 30, 1955, by class of highway and by fund

	Total cost	Federal funds	Miles	Railway-highway crossing improvements		
				Crossings eliminated	Structures reconstructed	Crossings protected
By Class of Highway						
Primary-rural:						
Interstate	$220,510,066	$119,238,924	1,462.2	43	4	1
All other	564,276,037	295,141,822	7,111.0	82	14	90
Secondary-rural	403,747,983	211,082,759	13,868.2	45	3	147
Urban:						
Interstate	374,559,783	182,850,478	390.2	88	5	2
All other	535,836,511	267,495,797	1,070.8	124	17	48
Subtotal	2,098,930,380	1,075,809,780	23,902.4	382	43	288
Not classified [1]	63,923,521	56,321,356	1,255.0			
Total	2,162,853,901	1,132,131,136	25,157.4	382	43	288
By Fund						
Federal-aid:						
Primary	$866,025,109	$448,893,678	8,699.3	150	26	122
Secondary	406,264,466	208,242,839	13,722.5	49	4	147
Urban	688,395,080	336,584,870	516.9	161	11	15
Interstate	115,142,422	66,077,742	702.1	18	2	
Prewar Federal-aid grade crossing	820,279	410,139				
Access Roads, Act of 1950	20,067,024	14,428,982	261.6	4		4
Defense Highway Act	2,216,000	1,171,530				
Subtotal	2,098,930,380	1,075,809,780	23,902.4	382	43	288
National forest highway [2]	34,267,719	30,949,223	890.1			
Tongass National Forest, Alaska [2]	656,000	656,000	4.4			
National park and parkway [3]	17,776,826	17,776,826	273.9			
Public lands	3,389,550	3,046,941	49.2			
Emergency flood relief	7,833,426	3,892,366	37.4			
Subtotal	63,923,521	56,321,356	1,255.0			
Total	2,162,853,901	1,132,131,136	25,157.4	382	43	288

[1] Forest, park, public lands, and emergency flood-relief projects.
[2] Includes construction projects only.
[3] Construction supervised by Bureau of Public Roads.

Table 3.—Projects financed with Federal-aid funds programed [1] during the fiscal year ended June 30, 1955, by State

State or Territory	Primary			Secondary			Urban			Interstate			Total		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$13, 165, 254	$7, 250, 694	145. 0	$13, 982, 139	$6, 870, 670	616. 2	$3, 455, 823	$1, 915, 483	14. 0	$3, 171, 600	$1, 791, 836	28. 9	$33, 774, 816	$17, 828, 683	804. 1
Arizona	8, 990, 897	6, 462. 627	136. 1	4, 789, 429	3, 258, 779	143. 2	662, 703	536, 307	1. 2	1, 853, 422	1, 496, 482	36. 8	16, 096, 451	11, 754, 195	317. 3
Arkansas	9, 978, 420	5, 026, 045	140. 7	9, 700, 922	4, 721, 314	415. 6	1, 460, 968	730, 484	1. 0	175, 038	93, 769		21, 515, 348	10, 571, 612	557. 3
California	27, 102, 667	13, 885, 050	87. 7	17, 500, 666	9, 927, 057	285. 8	33, 594, 416	16, 132, 676	22. 8	16, 777, 676	9, 609, 990	29. 9	94, 975, 425	49, 554, 773	426. 2
Colorado	9, 335, 127	5. 087, 954	94. 3	7, 051, 944	3, 616, 783	192. 4	579, 514	327, 078	. 5	720, 266	405, 545	5. 9	17, 686, 851	9, 437, 360	293. 1
Connecticut	221, 428	110, 714	. 7	1, 454, 204	721, 268	6. 7	5, 785, 668	2, 877, 681	. 9	41, 415	24, 849		7, 502, 715	3, 734, 512	8. 3
Delaware	1. 710, 584	857, 504	8. 1	2, 282, 968	1, 148, 852	21. 6				12, 138	10, 310		4, 005, 690	2, 016, 666	29. 7
Florida	11, 792, 980	6, 124, 786	120. 5	6, 607, 518	3, 290, 256	222. 5	8, 931, 347	4, 813, 453	15. 3	1, 386, 994	759, 344	. 7	28, 718, 839	14, 987, 839	359. 0
Georgia	17, 732, 595	8, 797, 528	215. 0	15, 056, 832	7, 564, 239	614. 7	4, 935, 154	2, 007, 825	6. 1				37, 724, 581	18, 369, 592	835. 8
Idaho	7, 071, 008	4, 518, 129	104. 7	5, 001, 146	3, 110, 581	166. 5	1, 597, 392	1, 248, 767	3. 1	751, 118	526, 268		14, 420, 664	9, 403, 745	274. 3
Illinois	24, 845, 863	13, 349, 523	110. 9	18, 545, 983	9, 289, 631	629. 5	30, 769, 550	16, 885, 052	6. 6	13, 112, 659	7, 772, 184	61. 5	87, 274, 055	47, 296, 390	808. 5
Indiana	17, 027, 300	8, 773, 148	86. 7	14, 997, 711	7, 658, 764	73. 7	11, 632, 879	6, 648, 076	1. 7	105, 479	63, 287		43, 763, 369	23, 143, 275	162. 1
Iowa	17, 848, 677	9, 347, 846	338. 1	15, 480, 114	7, 767, 960	986. 5	6, 642, 835	3, 797, 889	25. 7	1, 195, 254	717, 149	16. 0	41, 166, 880	21, 630, 844	1, 366. 3
Kansas	14, 053, 853	7, 078, 132	327. 1	12, 509, 024	6, 154, 600	1, 137. 9	2, 928, 162	1, 445, 332	8. 1	3, 881, 341	2, 328, 803	41. 5	33, 372, 380	17, 006, 867	1, 514. 6
Kentucky	14, 587, 798	7, 712, 657	89. 4	13, 401, 360	6, 675, 481	573. 6	2, 415, 792	1, 245, 396	6. 7	1, 259, 404	673, 331	3. 8	31, 664, 354	16, 306, 865	673. 5
Louisiana	15, 191, 183	7, 617, 853	251. 4	8, 096, 860	4, 048, 430	204. 2	6, 966, 679	3, 498, 169	3. 9				30, 254, 722	15, 164, 452	459. 5
Maine	8, 568, 099	4, 348, 879	88. 2	4, 339, 582	2, 178, 271	54. 6	798, 690	466, 845	1. 5	2, 322, 940	1, 347, 470	5. 0	16, 029, 311	8, 341, 465	149. 3
Maryland	6, 757, 706	3, 378, 853	12. 6	2, 001, 626	1, 202, 050	79. 5	10, 803, 580	5, 346, 280	11. 9	3, 661, 244	2, 041, 509	5. 2	23, 224, 156	11, 968, 692	109. 2
Massachusetts	5, 628, 034	2, 730, 899	13. 9	4, 142, 998	2, 062, 959	18. 9	1, 743, 065	866, 417	. 7	1, 297, 340	640, 426	1. 6	12, 811, 437	6, 300, 701	35. 1
Michigan	26, 725, 916	13, 493, 258	264. 2	14, 520, 046	7, 268, 064	560. 1	17, 883, 970	8, 919, 485	7. 9	8, 529, 619	5, 082, 846	22. 7	67, 659, 551	34, 768, 653	854. 9
Minnesota	17, 244, 606	8, 657, 230	343. 0	12, 975, 330	6, 611, 314	1, 538. 1	4, 822, 564	2, 643, 353	21. 7	3, 559, 666	2, 253, 095	55. 6	38, 602, 166	20, 164, 992	1, 958. 4
Mississippi	14, 202, 866	7, 373, 506	295. 0	11, 826, 068	5, 278, 774	590. 0	1, 862, 536	1, 131, 368	3. 5	4, 503, 100	2, 682, 360	23. 4	32, 394, 570	16, 466, 008	911. 9
Missouri	19, 158, 703	10, 138, 061	173. 4	15, 063, 814	7, 562, 105	1, 410. 4	10, 953, 208	5, 501, 391	8. 1	8, 591, 006	5, 102, 420	41. 3	53, 766, 731	28, 303, 977	1, 633. 2
Montana	11, 993, 536	8, 041, 128	234. 0	5, 593, 857	3, 304, 105	181. 0	369, 686	209, 982	2. 7				17, 957, 079	11, 555, 215	417. 7
Nebraska	15, 645, 113	8, 914, 316	285. 6	13, 531, 917	6, 887, 339	777. 7	1, 523, 586	763, 169	4. 1				30, 700, 616	16, 564, 824	1, 067. 4
Nevada	4, 984, 097	4, 102, 611	79. 1	1, 614, 701	1, 348, 316	54. 0	441, 814	440, 024	. 3	394, 771	342, 897	2. 5	7, 435, 383	6, 233, 848	135. 9
New Hampshire	4, 149, 327	2, 121, 117	22. 2	1, 918, 232	954, 629	12. 9	563, 001	278, 156	3. 3	276, 915	255, 598		6, 907, 475	3, 609, 500	38. 4
New Jersey	10, 078, 106	5, 026, 083	23. 2	5, 115, 798	2, 242, 434	31. 8	16, 365, 802	7, 707, 501	23. 5	9, 818	4, 909		31, 569, 524	14, 980, 927	78. 5
New Mexico	5, 795, 899	3, 662, 957	86. 1	5, 487, 412	3, 427, 259	204. 0	937, 919	590, 767	5. 8	2, 860, 565	1, 961, 773	44. 2	15, 081, 795	9, 642, 756	340. 1
New York	49, 745, 672	24, 596, 001	117. 2	7, 166, 517	3, 544, 358	52. 6	44. 546, 321	21, 318, 927	20. 5	299, 642	182, 404		101, 758, 152	49, 641, 670	190. 3
North Carolina	19, 182, 251	9, 081, 926	206. 9	16, 772, 802	8, 098, 736	344. 3	3, 316, 331	1, 670, 001	12. 9	4, 562, 183	2, 656, 792	33. 2	43, 833, 567	21, 507, 455	597. 3
North Dakota	10, 616, 957	5, 382, 241	406. 2	9, 282, 701	4, 651, 174	1, 358. 7	1, 514, 272	689, 246	4. 1	1, 391, 307	834, 784	19. 4	22, 805, 237	11, 557, 445	1, 788. 4

Ohio	24,402,245	12,219,004	39.4	10,903,527	5,599,388	80.1	22,760,768	10,676,266	9.6	9,748,535	5,849,121	18.9	67,815,075	34,343,779	148.0
Oklahoma	12,340,550	6,117,372	155.2	5,824,645	3,013,738	273.5	3,082,700	1,660,191	7.0				21,247,895	10,791,301	435.7
Oregon	7,677,136	4,628,343	71.0	5,277,201	3,200,717	189.6	3,054,000	1,763,807	5.6	2,515,181	1,723,960	20.8	18,523,518	11,316,827	287.0
Pennsylvania	30,923,443	15,535,172	115.5	12,262,023	6,142,938	109.1	23,047,446	11,308,448	5.3	14,869,998	8,921,999	25.5	81,102,910	41,908,557	255.4
Rhode Island	2,023,211	1,023,211	2.4	2,678,558	1,339,279	14.3	2,402,999	1,202,999	.3				7,104,768	3,565,489	17.0
South Carolina	15,842,450	8,340,456	128.6	4,032,749	2,037,094	300.4	2,084,557	1,127,868	3.2	737,898	450,748	10.2	22,697,654	11,956,166	442.4
South Dakota	7,475,346	4,189,816	339.9	6,582,930	3,797,787	534.8	1,793,116	987,470	4.4	3,001,827	1,920,924	82.3	18,853,219	10,895,997	961.4
Tennessee	14,789,596	6,998,498	164.4	5,653,194	2,826,597	406.8	8,619,988	4,159,994	5.4	110,692	55,346		29,173,470	14,040,435	576.6
Texas	45,711,413	23,997,935	606.5	23,943,470	11,974,050	1,212.3	7,371,071	3,797,950	15.2	15,457,641	9,777,300	132.1	92,483,595	49,547,235	1,966.1
Utah	5,574,610	4,072,541	83.0	3,402,865	2,541,246	99.1	614,686	458,685		2,145,126	1,707,734	25.2	11,737,287	8,780,209	207.3
Vermont	1,205,381	816,654	2.6	2,344,040	1,175,627	34.3	5,138	2,569		17,055	10,233		3,571,614	2,005,083	36.9
Virginia	10,676,168	5,396,783	105.8	6,354,512	3,221,971	235.9	2,198,066	1,041,403	2.9	1,889,173	1,037,721	17.5	21,117,919	10,697,878	362.1
Washington	8,596,755	4,896,132	99.2	8,341,603	4,440,028	233.2	6,050,046	3,375,410	3.9	2,090,261	1,310,560	13.6	25,078,665	14,022,130	349.9
West Virginia	6,658,114	3,366,639	68.0	3,552,898	1,834,762	22.5	1,466,888	741,888	1.0	30,683	30,683		11,708,583	5,973,972	91.5
Wisconsin	17,059,228	8,502,599	161.0	13,415,173	6,413,897	502.3	7,949,382	3,987,754	11.1	770,000	385,000	1.2	39,193,783	19,289,250	675.6
Wyoming	5,763,960	3,699,648	104.3	3,904,919	2,527,762	168.4	364,511	235,676	2.0	2,084,045	1,478,919	20.8	12,117,435	7,942,005	295.5
District of Columbia	4,199,658	2,105,172	2.4	2,376,166	1,186,867	5.0	2,700,072	1,350,036	1.5	486,250	243,125		9,762,146	4,885,200	8.9
Hawaii	2,415,380	1,040,040	10.6	3,272,450	1,618,535	4.1	920,806	388,953	.6				6,608,636	3,047,528	15.3
Puerto Rico	24,590	24,590		2,139,421	1,037,118	13.0	83,560	22,305					2,247,571	1,084,013	13.0
Total	664,491,756	350,024,864	7,167.0	423,874,565	218,375,933	17,997.9	337,375,027	170,942,252	329.1	142,658,285	86,565,803	847.2	1,568,399,633	825,908,852	26,341.2

[1] Initial commitment of funds.

Table 4.—Projects involving Federal funds awarded to contract [1] during the fiscal year ended June 30, 1955, by program and by State

State or Territory	Total cost	Total Federal funds	Federal-aid funds				Other [4]	Miles
			Primary [2]	Secondary	Urban [3]	Interstate		
Alabama	$25,529,267	$13,232,260	$3,761,939	$7,386,470	$1,239,211	$315,640	$529,000	737.7
Arizona	14,578,554	10,436,758	6,236,177	2,282,026	947,961	829,594	141,000	319.9
Arkansas	21,453,475	10,975,568	4,756,916	5,215,840	854,692	50,000	98,120	668.2
California	99,821,516	51,159,304	15,795,999	7,303,306	18,120,033	8,359,466	1,580,500	384.0
Colorado	15,986,990	8,655,509	5,004,864	2,423,299	425,040	636,314	165,992	266.7
Connecticut	10,987,923	5,474,561	559,367	597,603	4,315,135	2,456		10.6
Delaware	6,811,928	3,435,694	1,546,598	1,253,555	505,799	129,742		22.1
Florida	23,723,462	12,079,650	5,373,786	2,872,411	3,111,442	721,511	500	298.8
Georgia	36,615,353	17,911,550	8,929,649	5,803,572	2,202,176	297,953	678,200	760.2
Idaho	12,372,816	7,992,972	2,725,779	3,525,378	718,009	835,191	188,615	288.5
Illinois	77,811,945	41,204,762	10,094,111	9,073,649	16,557,202	5,479,800		748.5
Indiana	56,033,152	29,325,753	12,736,966	6,258,813	10,203,693	17,881	108,400	202.1
Iowa	30,432,356	15,832,381	9,381,150	4,142,362	1,644,908	663,961		982.3
Kansas	35,643,504	18,045,263	7,461,209	6,411,269	2,387,344	1,731,890	53,551	1,516.2
Kentucky	28,279,081	14,366,603	7,265,934	5,096,547	2,004,122			418.3
Louisiana	31,129,422	15,618,375	8,004,323	4,577,595	3,003,379		33,078	428.1
Maine	11,595,925	6,049,489	3,248,635	2,143,590	366,306	168,158	122,800	101.9
Maryland	12,303,476	6,768,425	2,026,756	937,251	3,055,779	189,639	559,000	131.6
Massachusetts	14,675,527	7,229,471	423,027	2,094,989	4,067,634	630,821	13,000	27.8
Michigan	48,664,783	24,400,668	9,707,672	4,772,094	8,614,572	1,204,550	101,780	661.7
Minnesota	35,367,303	18,205,513	9,103,168	6,101,278	1,875,589	1,125,478		1,982.7
Mississippi	31,186,144	16,044,070	7,871,780	4,946,623	1,380,904	1,843,563	1,200	792.2
Missouri	51,464,791	27,158,482	10,380,738	8,319,387	3,867,530	4,317,043	273,784	1,698.2
Montana	17,006,722	10,223,221	6,143,156	3,387,758	692,070	237		397.4
Nebraska	30,306,004	16,286,042	10,136,031	4,608,153	964,924	500,434	76,500	881.2
Nevada	8,163,909	6,828,449	4,551,224	1,487,914	441,564	347,747		160.1
New Hampshire	7,594,582	3,891,850	2,379,431	477,602	775,573	259,244		39.1
New Jersey	14,718,074	6,852,897	585,061	972,494	5,084,887	210,455		53.2
New Mexico	17,957,306	11,429,473	5,000,081	3,875,922	792,610	1,760,860		355.3
New York	109,428,103	53,221,268	18,036,596	4,892,326	28,575,497	487,308	1,229,541	178.7
North Carolina	39,157,294	19,459,308	7,587,983	6,977,548	2,237,445	1,945,057	711,275	547.6
North Dakota	18,019,385	9,201,688	4,690,938	3,277,453	348,625	884,672		1,356.2

Ohio	37,656,062	19,178,827	6,779,519	3,702,516	7,043,741	1,431,790	221,261	129.3
Oklahoma	29,193,481	15,591,727	8,564,262	3,823,955	2,718,410		485,100	506.0
Oregon	11,476,715	7,077,517	3,122,483	2,642,610	37,030	1,260,394	15,000	252.3
Pennsylvania	51,605,617	25,849,439	8,582,268	6,692,699	9,374,472	1,200,000		153.6
Rhode Island	9,027,608	4,526,809	1,609,341	1,674,262	1,003,727	239,479		31.7
South Carolina	17,392,643	9,096,818	5,052,153	1,986,130	1,479,346	394,739	184,450	295.0
South Dakota	12,332,917	7,064,346	3,649,836	2,348,091	1,054,712	11,707		622.4
Tennessee	29,688,556	14,299,143	8,459,212	3,232,349	2,572,715		34,867	711.8
Texas	87,185,208	46,151,883	20,920,815	11,215,530	5,803,150	7,431,600	780,788	1,850.0
Utah	11,005,118	8,035,161	3,921,138	2,639,790	315,437	496,751	662,045	316.8
Vermont	5,920,951	3,093,173	1,710,901	1,028,868	351,576	1,828		55.3
Virginia	25,993,093	12,946,536	4,834,534	5,019,944	2,277,117	465,041	349,900	444.1
Washington	17,660,521	9,533,555	3,083,401	3,146,863	2,947,189	139,491	216,611	297.5
West Virginia	10,718,165	5,436,415	3,806,940	1,106,219	263,973	244,283	15,000	80.9
Wisconsin	33,021,252	16,647,548	6,940,944	5,139,389	4,544,434	17,781	5,000	519.9
Wyoming	10,946,531	7,146,760	3,640,117	1,757,543	272,885	1,476,215		275.0
Alaska	5,000	5,000					5,000	
District of Columbia	10,575,335	4,820,848	3,003,591	951,828	622,304	243,125		5.1
Hawaii	4,882,659	2,206,948	885,043	1,108,031	213,874			12.9
Puerto Rico	6,468,801	3,114,621	1,392,352	1,348,322	372,607		1,340	32.0
Total	1,417,576,305	740,820,351	311,465,894	194,061,016	174,650,354	51,000,889	9,642,198	24,008.7

[1] Includes force-account projects placed under construction during the fiscal year.
[2] Funds available for either rural or urban portions of the Federal-aid primary highway system.
[3] Funds available for either urban portions of Federal-aid primary highway system or urban extensions of Federal-aid secondary highway system.
[4] Includes prewar Federal-aid grade crossing and 1950 Act access funds.

Table 5.—Status of Federal-aid projects [1] as of June 30, 1955, and projects completed during the fiscal year

State or Territory	Programmed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$17,420,218	$9,501,539	414.3	$4,881,356	$2,590,846	48.1	$45,424,876	$23,155,407	752.8	$31,280,056	$15,708,563	562.8
Arizona	4,936,718	3,999,862	110.5	3,323,443	2,345,161	53.2	8,781,717	6,464,521	170.7	12,537,056	8,880,426	323.7
Arkansas	9,764,408	5,263,304	334.4	4,378,490	2,339,737	48.1	18,850,127	9,464,240	504.8	20,511,573	10,299,754	615.8
California	19,017,494	10,128,013	303.0	15,501,614	7,981,472	14.8	124,642,642	62,251,047	334.2	78,330,197	39,793,613	371.9
Colorado	4,280,226	2,440,945	73.5	1,724,346	771,544	8.7	19,593,054	10,712,189	221.5	19,679,756	9,739,780	259.5
Connecticut	1,534,303	771,293	6.7	1,501,303	733,208	2.5	8,455,951	4,159,300	10.8	7,316,524	3,731,105	12.3
Delaware	888,182	454,403	15.4	2,055,783	1,034,480	4.9	6,419,111	3,551,831	25.7	5,380,302	2,707,620	35.6
Florida	25,683,496	13,365,948	378.8	5,935,393	2,980,535	61.1	25,185,577	12,967,546	288.9	21,527,194	10,899,960	360.0
Georgia	16,767,246	8,631,715	355.5	6,302,830	2,719,819	27.1	51,869,267	24,888,460	931.2	25,089,416	12,167,350	420.0
Idaho	6,334,824	4,036,314	94.2	5,085,122	3,337,152	112.8	15,276,613	9,735,395	242.0	16,016,003	9,943,390	379.3
Illinois	36,536,172	20,160,950	432.0	16,783,924	9,207,470	41.7	92,482,726	48,264,610	763.4	60,341,326	32,140,846	516.5
Indiana	24,903,989	13,496,202	117.4	14,695,868	7,375,066	76.3	53,376,258	27,965,884	180.8	26,159,001	13,472,718	163.4
Iowa	21,011,558	11,272,842	878.1	4,250,152	2,378,872	66.4	27,282,410	14,870,988	912.5	30,271,015	15,532,473	1,035.1
Kansas	10,543,318	5,455,139	986.1	4,985,949	2,547,004	136.2	23,856,923	11,897,140	883.6	29,406,639	14,902,342	1,500.2
Kentucky	13,195,704	6,826,533	359.6	8,622,156	4,709,884	70.6	32,434,641	16,285,154	445.0	18,649,987	9,879,359	267.6
Louisiana	12,160,962	6,080,481	107.1	8,493,352	4,246,676	135.0	39,025,191	18,389,635	378.3	20,825,059	10,331,940	134.5
Maine	11,217,814	6,152,337	92.0	288,058	146,252	2.4	16,304,712	8,455,240	129.3	8,936,399	4,504,406	70.6
Maryland	20,086,636	10,579,805	60.9	6,440,200	2,954,605	16.1	12,964,091	7,173,717	113.5	9,986,502	5,032,683	117.7
Massachusetts	6,213,686	3,096,843	23.2	3,685,561	1,830,881	6.6	49,053,158	22,944,011	51.5	22,829,095	11,336,990	20.3
Michigan	55,994,750	28,863,655	783.3	13,107,100	6,673,880	128.7	42,808,877	21,690,675	417.9	45,901,335	21,114,607	605.2
Minnesota	9,972,880	5,422,912	466.8	12,775,942	6,590,883	999.0	31,053,911	16,217,060	1,022.7	30,634,441	15,974,106	1,617.0
Mississippi	11,314,346	5,413,883	476.7	8,589,543	4,724,586	135.4	28,433,326	14,659,621	698.4	23,699,799	11,858,051	717.4
Missouri	18,270,210	9,315,454	976.7	4,052,804	2,364,272	21.6	80,552,570	41,859,186	1,456.4	30,814,352	15,102,918	916.7
Montana	14,535,155	9,353,151	286.8	3,967,210	2,405,181	148.6	24,910,089	15,535,099	515.4	15,175,814	8,959,333	425.3
Nebraska	22,885,343	11,969,747	1,006.9	9,260,321	4,336,895	161.6	27,610,350	15,451,343	699.4	18,246,695	9,396,029	621.9
Nevada	2,047,000	1,710,998	68.3	153,891	128,574	4.5	8,075,957	6,758,818	139.4	8,999,194	7,344,472	274.8
New Hampshire	4,222,000	2,111,000	27.0	8,931	8,038	----------	8,810,727	4,475,386	49.8	5,823,267	2,980,910	28.3
New Jersey	17,672,000	8,529,000	68.5	4,858,750	2,409,275	13.4	21,369,504	9,661,187	48.2	12,210,106	5,890,645	18.6
New Mexico	3,094,292	1,985,304	72.9	2,575,051	1,667,474	89.6	13,330,309	8,452,515	217.7	12,732,503	8,015,003	364.9
New York	29,698,067	15,762,186	100.9	50,724,426	24,475,210	91.5	202,127,264	95,239,993	268.5	99,118,993	47,854,736	408.7
North Carolina	23,127,426	11,385,563	424.4	6,933,486	3,651,113	97.5	41,719,748	20,412,988	581.1	37,343,068	17,486,504	512.3
North Dakota	7,168,845	3,621,798	1,070.6	10,874,170	5,383,943	782.9	9,086,346	4,706,718	485.9	15,123,872	7,518,449	1,392.6

Ohio	54,860,807	27,729,227	127.5	5,250,431	2,656,311	30.0	70,947,042	34,185,001	146.0	81,451,767	40,060,593	198.2
Oklahoma	5,062,787	2,631,393	183.0	17,583,298	9,029,908	239.5	25,808,712	13,674,492	365.0	17,420,178	9,331,119	339.3
Oregon	7,925,274	4,722,800	102.4	2,563,745	1,518,364	24.1	16,206,520	10,019,894	242.6	11,878,827	7,175,748	292.6
Pennsylvania	56,080,740	29,327,370	116.2	17,518,820	8,953,993	42.9	97,890,341	48,485,487	234.7	57,484,788	28,694,395	149.1
Rhode Island	5,738,948	2,869,474	13.1	185,338	92,669		11,337,878	5,681,944	36.9	5,421,603	2,713,083	30.9
South Carolina	15,709,930	8,356,722	416.1	1,273,235	749,116	5.3	19,034,282	10,057,770	297.3	14,248,511	7,145,933	551.1
South Dakota	16,668,818	9,643,060	915.6	2,227,882	1,298,118	107.9	8,814,394	5,051,324	401.0	12,469,429	7,123,468	725.4
Tennessee	16,638,050	8,274,225	306.2	5,243,866	2,621,933	38.0	38,575,764	17,483,258	591.1	26,720,428	13,193,298	689.5
Texas	19,260,700	10,512,295	488.2	13,205,881	6,631,750	114.8	84,820,227	44,658,512	1,231.8	69,198,893	37,679,563	1,792.8
Utah	8,017,453	6,094,283	140.0	2,578,459	2,017,965	103.5	10,679,100	7,970,327	210.1	10,454,685	7,864,197	273.2
Vermont	917,200	462,520	14.3	281,908	229,662	.4	8,823,158	4,530,090	86.7	6,388,646	3,215,043	39.1
Virginia	13,188,775	7,446,331	279.5	5,279,896	2,468,275	38.9	23,338,545	11,933,991	318.9	30,851,414	14,690,005	310.6
Washington	17,722,365	9,815,560	190.9	3,391,504	1,984,527	134.3	23,851,498	12,828,195	175.7	17,980,772	9,689,335	342.0
West Virginia	10,856,178	5,720,221	57.9	4,764,170	2,394,033	40.0	13,818,975	6,961,701	49.0	9,673,862	4,842,308	52.8
Wisconsin	16,657,270	8,274,747	328.9	10,563,160	5,276,361	67.8	39,575,265	19,832,397	542.3	22,398,627	11,241,341	450.8
Wyoming	4,302,952	2,787,770	89.8	3,167,415	2,068,693	65.6	13,504,948	8,670,063	292.6	8,096,592	5,135,924	227.5
Alaska							5,000	5,000		62,591	62,591	6.5
District of Columbia	5,225,000	2,612,500	7.1	274,934	137,425	.6	12,751,827	6,038,123	2.9	8,074,588	4,170,176	4.3
Hawaii	2,625,714	1,395,167	5.7	2,377,600	1,183,350	.8	5,478,209	2,451,896	12.7	10,431,098	4,871,826	17.2
Puerto Rico	2,648,410	1,288,410	15.6	4,676,283	2,284,285	16.8	13,275,322	5,926,685	45.7	8,584,364	4,019,946	21.1
Total	762,606,639	407,123,194	14,770.5	349,225,350	180,646,726	4,678.1	1,749,705,030	895,163,054	19,224.3	1,250,188,202	643,420,973	21,584.5

[1] Includes projects financed from Federal-aid primary, secondary, urban, and interstate, prewar Federal-aid primary, secondary, and grade-crossing, Defense Highway Act, and 1950 Act access funds.

[2] Initial commitment of funds.

Table 6.—Improvements on the Federal-aid primary system in rural areas, financed with Federal-aid funds:[1] Status of projects as of June 30, 1955, and projects completed during the fiscal year

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$9,196,394	$5,175,427	113.8	$3,360,160	$1,757,088	41.1	$21,052,860	$10,918,617	146.0	$16,336,271	$8,284,912	164.4
Arizona	1,433,191	1,164,659	10.4	2,152,488	1,566,235	33.3	5,505,200	3,991,940	104.0	6,933,796	4,930,987	122.2
Arkansas	4,121,278	2,265,889	71.4	3,101,792	1,554,760	45.9	8,412,253	4,236,778	141.7	9,560,792	4,756,118	188.7
California	568,000	236,000		3,622,622	1,848,014	9.3	42,475,483	20,626,076	135.1	24,468,895	12,149,256	70.1
Colorado	1,109,361	634,814	10.1				10,005,570	5,477,777	93.0	8,775,508	4,792,482	81.1
Connecticut	522,843	265,563	2.4				774,870	386,447	1.0	2,500,263	1,286,791	10.1
Delaware	53,782	29,835		308,044	154,022	1.9	1,819,170	912,326	9.1	4,974,880	2,485,066	31.8
Florida	11,154,828	5,731,814	123.7	3,819,672	1,918,373	41.9	10,380,392	5,284,532	132.4	5,986,398	2,926,288	106.3
Georgia	6,068,000	3,040,700	74.5	2,181,155	1,068,103	18.8	16,810,640	8,444,096	229.9	8,563,648	4,321,711	86.8
Idaho	3,418,035	2,179,721	32.0	3,846,254	2,397,413	67.8	7,893,090	4,933,953	60.1	6,334,438	4,013,058	101.0
Illinois	4,901,365	2,786,446	28.2	9,570,665	5,622,428	32.0	30,516,746	16,610,354	179.8	22,353,284	11,221,224	154.4
Indiana	10,179,949	5,136,622	24.1	9,200,487	4,603,322	60.3	23,444,708	11,950,152	93.3	8,204,950	4,072,251	73.9
Iowa	3,642,296	2,086,811	45.4	3,579,448	2,022,328	63.0	14,319,628	7,581,525	299.6	14,611,331	7,512,991	311.7
Kansas	2,405,724	1,359,142	45.7	3,559,561	1,785,966	124.9	10,553,576	5,372,280	246.0	14,423,522	7,319,897	355.3
Kentucky	4,307,410	2,204,486	17.0	3,970,091	2,055,642	46.2	12,406,472	6,259,201	85.2	5,999,733	3,001,367	86.4
Louisiana	4,995,820	2,497,910	45.0	5,305,156	2,652,578	105.7	9,706,037	4,757,930	112.7	5,306,346	2,652,257	50.1
Maine	6,033,412	3,232,006	34.2	288,058	146,252	2.4	5,144,873	2,672,830	55.2	3,875,627	1,905,469	28.1
Maryland	10,726,150	5,573,962	19.0	2,522,000	1,042,265	14.6	754,390	377,195	5.3	5,851,596	2,923,053	21.8
Massachusetts	2,884,000	1,432,000	6.4	2,498,727	1,236,963	6.6	7,986,225	3,716,150	10.7	3,128,594	1,485,679	7.2
Michigan	24,614,200	13,074,880	140.4	4,955,100	2,557,530	88.1	14,211,819	7,171,136	167.4	11,616,905	5,588,915	133.8
Minnesota	3,112,591	1,783,756	27.3	2,424,940	1,285,320	90.0	15,862,888	8,327,876	323.3	13,378,773	6,957,054	275.6
Mississippi	2,742,804	1,580,712	21.3	4,189,592	2,201,336	105.2	13,773,567	7,232,857	295.2	10,371,693	5,407,363	169.2
Missouri	1,553,726	788,632	8.2	2,897,470	1,625,477	18.0	32,301,590	17,682,691	231.1	14,563,239	6,884,710	116.5
Montana	8,481,572	5,764,775	112.7	2,162,559	1,375,758	76.7	16,335,909	10,512,146	325.5	7,479,650	4,525,793	146.7
Nebraska	8,431,232	4,495,616	128.2	5,041,669	2,577,569	144.2	13,267,423	6,681,946	262.1	9,947,971	4,988,147	269.0
Nevada	1,647,000	1,376,276	38.8				4,666,040	3,917,712	80.2	6,783,258	5,560,589	155.6
New Hampshire	2,704,000	1,352,000	17.1	8,931	8,038		3,660,439	1,756,961	25.6	1,831,284	870,265	15.1
New Jersey	7,750,000	3,875,000	12.9	1,242,840	613,650	1.8	105,324	52,662		520,272	221,462	.9
New Mexico	1,382,826	904,508	26.4	857,189	581,961	24.9	6,782,268	4,353,517	76.0	6,737,901	4,221,755	125.7
New York	11,317,850	5,984,119	25.8	19,677,049	9,947,102	74.2	32,116,645	15,322,581	106.3	29,106,795	13,592,643	241.1
North Carolina	12,606,458	6,369,689	170.4	4,775,786	2,471,073	73.5	17,855,641	8,525,327	199.0	21,307,406	10,033,203	270.2
North Dakota	1,701,723	876,677	47.1	5,602,960	2,812,544	226.5	5,894,385	3,114,917	206.8	9,265,712	4,598,520	469.5

Ohio	29,753,379	15,633,685	50.3	320,552	174,924		17,495,197	8,949,895	41.4	22,021,931	10,327,355	44.4
Oklahoma	1,784,500	909,371	13.5	9,200,470	4,492,300	96.6	15,167,452	7,887,844	159.8	8,807,198	4,631,874	76.1
Oregon	1,485,274	928,000	2.4	2,115,016	1,294,000	24.1	9,639,849	6,039,939	114.6	6,178,986	3,761,584	77.4
Pennsylvania	28,152,532	15,363,266	76.8	10,268,463	5,330,489	37.3	19,174,334	9,674,376	51.8	23,359,684	11,679,842	55.0
Rhode Island	1,730,000	865,000	2.4	79,498	39,749		4,190,463	2,106,837	14.6	2,904,398	1,449,530	11.2
South Carolina	11,470,630	6,141,972	137.9	480,077	261,808	2.2	6,047,760	3,251,412	38.8	3,487,477	1,774,318	19.1
South Dakota	8,923,677	5,187,731	298.2	2,227,882	1,298,118	107.9	3,518,566	1,976,673	163.4	7,517,431	4,238,837	317.8
Tennessee	3,600,992	1,802,496	30.4	3,997,502	1,998,751	35.6	12,637,936	5,963,968	184.0	13,352,477	6,222,924	165.5
Texas	11,864,500	6,801,395	151.8	8,900,074	4,510,800	93.6	40,953,001	22,068,899	478.1	22,019,583	11,431,646	387.9
Utah	4,221,953	3,242,544	47.5	1,826,312	1,327,194	48.3	5,756,740	4,300,396	67.1	5,455,601	4,034,679	59.6
Vermont				276,770	227,093	.4	5,303,428	2,780,077	37.3	2,960,031	1,521,979	9.1
Virginia	3,887,700	2,052,850	42.7	3,078,708	1,481,886	36.2	9,244,552	4,681,567	89.2	13,196,923	6,453,440	62.7
Washington	7,485,000	4,309,750	71.7	985,165	704,919	26.1	8,714,459	4,581,103	82.8	8,308,767	4,380,006	125.8
West Virginia	5,803,698	2,943,089	32.5	3,112,750	1,553,105	29.0	5,519,383	2,789,181	36.9	3,144,105	1,564,295	29.7
Wisconsin	4,800,968	2,403,684	34.5	7,316,486	3,652,277	58.3	13,511,821	6,690,147	131.7	11,668,421	5,952,717	104.6
Wyoming	2,091,783	1,350,971	30.0	2,369,850	1,552,232	41.6	9,067,169	5,805,503	141.8	4,124,809	2,626,952	54.2
District of Columbia	1,095,000	547,500	3.5				1,299,545	669,066				
Hawaii	378,488	189,244	.3				2,073,292	1,027,300	9.4	1,574,276	768,946	5.3
Puerto Rico	1,137,500	557,500	6.6	857,368	425,263	3.0	4,539,627	2,169,057	12.9	2,117,074	1,005,953	4.4
Total	305,435,394	166,490,495	2,512.9	174,135,408	91,814,018	2,279.0	610,650,695	322,566,728	6,294.2	483,299,903	249,318,153	6,050.1

[1] Includes projects on rural portions of the Federal-aid primary highway system financed from Federal-aid primary and interstate, prewar Federal-aid primary and grade-crossing, Defense Highway Act, and 1950 Act access funds.

[2] Initial commitment of funds.

Table 7.—Improvements on secondary roads in rural areas financed with Federal-aid funds:[1] Status of projects as of June 30, 1955, and projects completed during the fiscal year

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$5,830,904	$2,910,272	286.2	$178,540	$86,050	1.1	$14,815,598	$7,307,909	554.6	$8,004,654	$3,863,056	385.8
Arizona	3,503,527	2,835,203	100.1	985,696	695,044	18.9	2,122,195	1,533,278	66.3	3,734,998	2,778,257	189.6
Arkansas	3,845,828	1,785,214	256.7	278,282	140,797	1.2	7,540,094	3,783,572	353.4	9,973,469	5,052,272	421.4
California	15,657,494	9,253,513	299.8	743,276	663,562	.7	10,099,508	6,409,801	126.6	15,365,857	7,994,040	271.7
Colorado	3,015,864	1,718,649	63.5	1,359,645	565,414	8.4	3,460,262	1,973,985	120.9	5,032,770	2,615,011	176.6
Connecticut	910,948	455,474	4.3	387,398	188,685	2.0	1,185,916	577,556	3.4	1,419,058	753,414	2.0
Delaware	834,400	424,568	15.4	69,495	42,067	1.9	1,742,809	871,405	14.8	339,828	168,026	3.8
Florida	7,363,608	3,703,804	243.5				5,072,978	2,538,349	121.2	6,710,780	3,324,765	225.4
Georgia	8,537,046	4,502,415	275.0				16,153,503	8,149,747	664.8	7,253,259	3,880,357	285.9
Idaho	2,589,222	1,651,942	61.9	744,067	444,938	44.8	6,106,587	3,878,453	178.7	7,157,094	4,598,060	268.8
Illinois	13,716,807	6,857,004	398.8				17,971,704	8,983,587	569.2	9,314,876	4,573,060	318.5
Indiana	10,612,035	5,423,070	90.6	2,136,704	1,070,994	12.7	11,975,836	5,968,319	66.1	9,219,583	4,573,969	75.8
Iowa	12,891,650	6,474,225	813.1				8,747,417	4,393,473	598.8	7,689,138	3,824,127	656.9
Kansas	8,077,562	4,057,181	940.3	52,551	52,551	3.8	9,349,663	4,559,884	627.9	11,343,541	5,681,862	1,126.8
Kentucky	7,019,294	3,550,047	340.1	123,628	61,814	8.5	11,446,138	5,746,188	335.3	7,369,169	3,766,529	172.2
Louisiana	3,606,128	1,803,064	56.8				11,947,636	5,975,855	249.7	5,654,326	2,800,927	64.9
Maine	4,548,712	2,536,486	56.3				5,322,946	2,798,720	45.0	3,115,875	1,596,087	35.8
Maryland	2,497,406	1,449,303	32.9	23,000	23,000	.7	3,677,658	2,413,483	96.5	3,738,080	1,911,304	94.9
Massachusetts	3,219,686	1,609,843	16.8				3,462,993	1,724,981	18.5	1,661,183	961,741	8.3
Michigan	14,433,550	7,258,475	638.2				9,574,624	5,074,902	232.4	8,519,412	4,129,068	436.3
Minnesota	3,877,554	2,059,177	425.8	7,361,332	3,716,018	887.6	6,080,076	3,055,619	641.5	9,497,362	4,768,690	1,271.6
Mississippi	7,763,918	3,429,359	453.7				9,437,351	4,472,610	379.9	10,574,795	5,064,229	539.5
Missouri	10,491,862	5,272,111	963.0	272,683	272,683	2.8	14,714,572	7,360,980	1,183.0	9,041,900	4,535,446	773.2
Montana	5,704,901	3,389,824	172.3	1,312,277	749,754	67.9	6,892,226	3,995,391	170.9	7,487,898	4,314,698	278.6
Nebraska	13,887,476	7,171,213	874.6	190,725	95,362		10,429,432	6,052,289	421.1	6,633,383	3,371,000	342.8
Nevada	400,000	334,722	29.6	153,891	128,574	4.5	1,642,269	1,359,340	54.4	2,213,245	1,782,350	119.2
New Hampshire	1,368,000	684,000	9.1				1,151,008	573,299	12.5	1,133,923	545,677	9.7
New Jersey	4,702,000	2,044,000	51.6	417,990	208,865	6.9	1,067,158	531,954	13.1	676,712	328,206	6.6
New Mexico	1,697,927	1,072,280	46.5	1,717,862	1,085,514	64.8	3,629,708	2,259,559	118.2	4,376,928	2,766,498	231.4
New York	8,546,568	4,493,746	65.0	266,883	141,354	.5	17,406,284	8,156,425	99.5	11,826,760	5,705,940	91.9
North Carolina	8,137,280	3,847,530	246.9	633,500	455,940	8.2	11,767,281	5,852,628	285.2	7,848,498	3,969,519	214.5
North Dakota	5,460,280	2,741,700	1,023.5	4,172,750	2,090,059	552.3	3,191,961	1,591,801	279.0	5,449,190	2,715,445	923.1

Ohio	10,767,100	5,614,378	71.3	1,506,410	784,008	28.3	13,174,188	5,891,962	78.5	24,688,594	13,542,865	125.5
Oklahoma	2,068,287	1,081,060	163.5	3,089,828	1,783,676	125.3	6,049,449	3,203,352	188.1	5,500,633	2,836,205	255.8
Oregon	2,755,000	1,652,800	94.0				4,922,972	2,962,894	121.1	3,247,556	1,948,591	211.1
Pennsylvania	5,228,964	2,614,482	34.5				18,537,133	9,257,907	141.1	8,901,454	4,440,801	76.0
Rhode Island	1,608,948	804,474	10.4	48,136	24,068		2,590,262	1,295,081	19.4	1,431,507	709,464	12.8
South Carolina	3,360,500	1,690,400	276.1	54,903	41,177		4,123,884	2,076,043	228.6	6,653,621	3,321,397	520.4
South Dakota	7,745,140	4,455,329	617.4				3,502,712	2,087,181	233.2	4,025,097	2,364,692	401.5
Tennessee	6,874,010	3,390,205	272.1				6,810,178	3,270,860	380.6	9,494,892	4,650,564	519.8
Texas	7,288,200	3,656,900	336.3				15,819,624	7,999,150	642.2	24,978,479	12,794,189	1,311.5
Utah	2,895,500	2,177,909	89.9	700,661	644,726	55.0	3,575,728	2,534,975	142.6	4,059,774	3,133,048	210.5
Vermont	917,200	462,520	14.3				2,788,009	1,393,437	46.6	2,741,443	1,351,982	28.7
Virginia	7,067,100	4,072,475	231.2	218,395	99,284		8,085,466	4,424,994	223.9	6,822,671	3,279,101	233.1
Washington	5,201,465	2,802,760	116.6	2,015,145	1,052,717	107.5	4,401,105	2,558,006	76.2	5,560,638	3,062,031	200.8
West Virginia	3,051,144	1,776,464	22.4	1,651,420	840,928	11.0	1,360,574	694,567	6.2	2,864,346	1,437,544	22.5
Wisconsin	7,172,894	3,514,247	290.8				12,829,026	6,264,445	401.8	7,577,884	3,600,517	335.5
Wyoming	2,211,169	1,436,799	59.8	794,155	514,263	24.0	3,246,637	2,089,189	144.2	3,258,000	2,058,257	171.6
Alaska							5,000	5,000		62,591	62,591	6.5
District of Columbia	200,000	100,000	.5									
Hawaii	2,121,760	1,143,190	5.2	2,004,400	1,002,200	.8	1,317,410	624,633	1.2	2,997,199	1,410,470	9.0
Puerto Rico	865,910	428,410	7.1	1,585,149	767,069	10.0	4,172,458	1,990,586	28.2	2,181,583	1,036,376	16.3
Total	284,149,728	149,674,216	12,065.3	37,250,777	20,533,155	2,062.1	366,497,206	190,549,604	11,806.1	336,425,506	175,754,315	14,692.4

[1] Includes projects on secondary roads in rural areas financed from Federal-aid secondary, prewar Federal-aid secondary and grade-crossing, Defense Highway Act, and 1950 Act access funds.
[2] Initial commitment of funds.

Table 8.—Improvements in urban areas financed with Federal-aid funds: [1] Status of projects as of June 30, 1955, and projects completed during the fiscal year

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$2,392,920	$1,415,840	14.3	$1,342,656	$747,708	5.9	$9,556,418	$4,928,880	52.1	$6,939,130	$3,560,595	12.6
Arizona				185,259	83,883	1.0	1,154,323	939,303	.3	1,868,262	1,171,182	11.9
Arkansas	1,797,302	1,212,201	6.3	998,416	644,180	.9	2,897,780	1,443,890	9.7	977,312	491,364	5.6
California	2,792,000	638,500	3.2	11,135,716	5,469,896	4.8	72,067,651	35,215,170	72.5	38,495,444	19,650,316	30.1
Colorado	155,000	87,482		364,701	206,129	.2	6,127,221	3,260,427	7.7	5,871,479	2,332,286	1.8
Connecticut	100,512	50,256		1,113,906	544,522	.6	6,495,165	3,195,298	6.5	3,397,204	1,690,900	.2
Delaware				1,678,244	838,391	1.1	2,857,132	1,768,100	1.8	65,595	54,528	
Florida	7,165,060	3,930,330	11.6	2,115,721	1,062,162	19.2	9,732,207	5,144,665	35.4	8,830,016	4,648,907	28.2
Georgia	2,162,200	1,088,600	6.0	4,121,675	1,651,716	8.3	18,905,124	8,294,617	36.5	9,272,510	3,965,282	47.2
Idaho	327,568	204,651	.3	494,801	494,801	.2	1,276,937	922,990	3.3	2,524,471	1,332,272	9.5
Illinois	17,918,000	10,517,500	5.0	7,213,259	3,585,042	9.8	43,994,276	22,670,669	14.4	28,673,166	16,346,563	43.6
Indiana	4,112,005	2,936,510	2.8	3,358,677	1,700,750	3.3	17,955,714	10,047,413	21.3	8,734,467	4,826,499	13.7
Iowa	4,477,612	2,711,806	19.7	670,704	356,544	3.3	4,215,365	2,895,990	14.1	7,970,545	4,195,354	66.5
Kansas	60,032	38,816		1,373,837	708,487	7.5	3,953,684	1,964,976	9.7	3,639,575	1,900,582	18.1
Kentucky	1,869,000	1,072,000	2.5	4,528,437	2,592,428	15.9	8,582,031	4,279,765	24.4	5,281,085	3,111,463	9.0
Louisiana	3,559,014	1,779,507	5.4	3,188,196	1,594,098	29.3	17,371,518	7,655,850	15.8	9,864,387	4,878,756	19.5
Maine	635,690	383,845	1.4				5,836,893	2,983,690	29.1	1,944,897	1,002,850	6 6
Maryland	6,863,080	3,556,540	8.9	3,895,200	1,889,340	.9	8,532,042	4,383,039	11.8	396,826	198,326	1.0
Massachusetts	110,000	55,000		1,187,834	593,917		37,603,940	17,502,881	22.3	18,039,318	8,889,570	4.8
Michigan	16,947,000	8,530,300	4.7	8,152,000	4,116,350	40.6	19,022,434	9,444,637	18.1	25,765,018	11,396,624	35.1
Minnesota	2,982,735	1,579,979	13.8	2,989,670	1,589,545	21.4	9,110,947	4,833,565	58.0	7,758,307	4,248,362	69.8
Mississippi	807,624	403,812	1.8	4,399,951	2,523,250	30.1	5,222,408	2,954,154	23.4	2,753,310	1,386,459	8.7
Missouri	6,224,622	3,254,711	5.6	882,650	466,112	.9	33,536,409	16,815,515	42.3	7,209,213	3,682,762	27.0
Montana	348,682	198,552	1.8	492,374	279,668	4.0	1,681,954	1,027,562	19.1	208,265	118,843	
Nebraska	566,635	302,918	4.1	4,027,928	1,663,964	17.4	3,913,495	2,717,108	16.2	1,665,341	1,036,883	10.1
Nevada							1,767,648	1,481,766	4.8	2,691	1,533	
New Hampshire	150,000	75,000	.8				3,999,279	2,145,126	11.6	2,858,061	1,564,968	3.5
New Jersey	5,220,000	2,610,000	3.9	3,197,920	1,586,760	4.8	20,197,022	9,076,571	35.1	11,013,123	5,340,976	11.1
New Mexico	13,539	8,516					2,918,333	1,839,438	23.5	1,617,674	1,026,751	7.7
New York	9,833,650	5,284,321	10.1	30,780,494	14,386,754	16.9	152,604,334	71,760,987	62.7	58,185,438	28,556,152	75.8
North Carolina	2,383,688	1,168,344	7.1	1,524,200	724,100	15.8	12,096,826	6,035,033	96.9	8,187,164	3,483,782	27.6
North Dakota	6,842	3,421		1,098,460	481,349	4.1				408,970	204,485	

Ohio	14,340,328	6,481,164	5.9	3,423,469	1,697,379	1.6	40,277,658	19,343,143	26.1	34,741,242	16,190,373	28.4
Oklahoma	1,210,000	640,962	6.0	5,293,000	2,753,932	17.3	4,591,811	2,583,296	17.1	3,112,346	1,863,039	7.4
Oregon	3,685,000	2,142,000	5.9	448,728	224,364		1,643,699	1,017,061	7.0	2,452,285	1,465,573	4.1
Pennsylvania	22,699,244	11,349,622	4.9	7,250,357	3,623,504	5.7	60,178,874	29,553,204	41.8	25,223,650	12,573,752	18.1
Rhode Island	2,400,000	1,200,000	.3	57,704	28,852		4,557,153	2,280,026	2.9	1,085,699	554,089	6.9
South Carolina	878,800	524,350	2.1	738,255	446,131	3.0	8,862,638	4,730,314	29.9	4,107,413	2,050,218	11.7
South Dakota							1,793,116	987,470	4.4	926,901	519,939	6.1
Tennessee	6,163,048	3,081,524	3.7	1,246,364	623,182	2.4	19,127,650	8,248,430	26.6	3,873,058	2,319,810	4.3
Texas	108,000	54,000		4,305,807	2,120,950	21.2	28,047,601	14,590,464	111.5	22,200,831	13,453,728	93.4
Utah	900,000	673,830	2.6	51,486	46,045	.3	1,346,632	1,134,956	.4	939,310	696,470	3.1
Vermont				5,138	2,569		731,721	356,576	2.8	687,172	341,082	1.3
Virginia	2,233,975	1,321,006	5.6	1,982,793	887,105	2.7	6,008,527	2,827,430	5.8	10,831,820	4,957,464	14.8
Washington	5,035,900	2,703,050	2.6	391,194	226,892	.7	10,735,934	5,689,086	16.6	4,111,368	2,247,298	15.4
West Virginia	2,001,336	1,000,668	2.9				6,939,018	3,477,953	5.9	3,665,412	1,840,470	.6
Wisconsin	4,683,408	2,356,816	3.6	3,246,675	1,624,084	9.5	13,234,418	6,877,805	8.8	3,152,321	1,688,108	10.8
Wyoming				3,410	2,199		1,191,143	775,371	6.5	713,783	450,715	1.7
District of Columbia	3,930,000	1,965,000	3.1	274,934	137,425	.6	11,452,282	5,378,057	2.9	8,074,588	4,170,176	4.3
Hawaii	125,466	62,733	.2	373,200	181,150		2,087,507	799,963	2.0	5,859,623	2,692,410	2.9
Puerto Rico	645,000	302,500	1.8	2,233,765	1,091,953	3.8	4,563,237	1,767,042	4.6	4,285,707	1,977,616	.4
Total	173,021,517	90,958,483	192.3	137,839,165	68,299,553	337.0	772,557,129	382,046,722	1,124.0	430,462,793	218,348,505	842.0

[1] Includes projects in urban areas financed from Federal-aid primary, secondary, urban, and interstate, prewar Federal-aid primary, secondary, and grade-crossing, Defense Highway Act, and 1950 Act access funds.
[2] Initial commitment of funds.

Table 9.—Interstate system improvements financed with Federal-aid funds: [1] Status of projects as of June 30, 1955, and projects completed during the fiscal year

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$1,404,700	$834,320	6.7	$1,445,460	$748,746	23.4	$15,114,560	$7,705,763	83.9	$8,131,943	$4,127,275	55.7
Arizona	291,022	279,507	.2	741,783	648,584	6.6	2,577,225	1,893,991	42.6	4,078,130	2,922,236	61.5
Arkansas	994,504	702,502	20.1	324,202	164,477	.2	506,060	249,030	10.9	3,979,005	1,974,256	67.9
California	568,000	236,000		2,522,638	1,536,698	2.0	55,045,851	26,162,139	94.0	33,285,772	16,572,753	59.1
Colorado	674,362	388,660	1.2				9,664,945	5,292,662	38.5	9,335,912	4,213,200	36.5
Connecticut	41,415	24,849		1,113,906	544,522	.6	4,076,729	1,995,504	5.5	2,745,867	1,365,823	10.1
Delaware							1,229,164	617,323	1.8	4,255	1,818	
Florida	4,177,924	2,188,962	15.0				4,963,331	2,547,318	27.0	6,779,200	3,586,696	44.6
Georgia	3,815,200	1,910,800	20.7	2,839,797	991,797	.4	20,488,226	9,086,168	51.5	11,308,506	4,976,372	58.6
Idaho							1,837,470	1,179,595	10.1	3,758,627	2,200,958	36.7
Illinois	13,660,640	7,959,084	12.0	8,323,718	4,745,655	15.1	47,720,888	24,943,754	103.0	30,867,894	16,513,377	77.0
Indiana	5,309,929	3,511,512	4.9	1,196,950	598,475	.2	12,410,612	6,345,806	23.5	2,996,639	1,491,650	3.9
Iowa	88,650	53,188		464,080	276,639	6.4	660,606	396,363	9.6	1,920,089	888,784	28.8
Kansas	1,028,252	615,126	24.1	302,083	181,249	3.1	1,008,174	603,087		3,025,996	1,670,694	33.2
Kentucky	4,954,174	2,658,216	13.4	1,537,031	1,013,076	.4	3,121,379	1,511,940	9.2	2,078,786	1,048,193	11.5
Louisiana	1,193,856	596,928	6.5				8,374,427	3,827,485	49.2	3,099,272	1,549,260	16.8
Maine	2,041,624	1,179,312	5.1				2,626,914	1,417,630	4.6	1,932,866	967,128	4.4
Maryland	7,561,244	3,991,509	9.6	1,704,000	633,265	12.4	6,652	3,326		4,640,309	2,318,250	12.4
Massachusetts	117,000	48,500		19,210	9,605		7,441,509	3,223,130	5.2	10,839,231	5,326,162	6.8
Michigan	17,295,000	9,383,080	38.4	3,751,400	2,000,730	14.3	14,899,175	7,448,234	14.1	22,510,028	9,928,877	25.8
Minnesota	1,368,620	893,170	18.7	1,211,720	727,020	15.3	4,367,958	2,439,995	70.5	4,438,678	2,328,471	70.7
Mississippi	2,471,062	1,430,141	6.2	2,285,650	1,310,900	17.7	6,594,526	3,627,213	47.9	4,405,353	2,422,698	47.8
Missouri	5,018,842	2,521,190	3.5	1,486,308	884,751	3.2	38,067,118	20,094,011	106.2	9,540,566	4,836,811	37.3
Montana	2,137,042	1,443,025	21.0	735,289	417,652	38.0	3,122,303	1,958,206	27.3	2,439,610	1,604,524	43.9
Nebraska							2,526,535	2,021,851	13.4	576,328	318,614	15.2
Nevada							795,346	677,656	5.0	1,409,507	1,157,991	6.4
New Hampshire							1,723,493	1,007,130	5.1	742,051	527,037	.9
New Jersey							3,263,618	1,599,809	8.8	612,549	305,546	1.4
New Mexico	1,226,403	796,904	26.4	738,064	504,019	19.5	4,135,586	2,684,544	55.6	5,678,603	3,577,098	76.7
New York	2,856,710	1,460,937	7.8	6,106,000	2,775,480	2.9	87,452,132	40,792,250	24.5	13,585,218	6,278,046	8.7
North Carolina	2,746,686	1,441,673	34.8	2,266,220	1,232,805	20.0	11,514,632	5,647,767	86.5	7,923,680	3,088,540	61.9
North Dakota	48,157	28,894					1,404,318	834,888	23.9	2,280,013	1,133,224	66.8

Ohio	12,184,235	6,830,541	14.6	2,952,634	1,462,054	1.0	26,827,766	12,067,252	22.8	18,138,133	8,057,107	21.0
Oklahoma	500,000	266,650	4.0				2,782,700	1,436,078	14.2	5,072,505	2,667,859	9.9
Oregon	3,123,397	1,927,000	4.2	579,978	356,000	3.2	5,914,914	3,748,214	56.0	5,663,508	3,441,061	29.2
Pennsylvania	15,703,614	9,138,807	23.6	7,719,098	4,059,549	7.0	40,697,463	20,037,000	21.1	36,437,930	18,211,465	39.9
Rhode Island	2,400,000	1,200,000	.3	7,292	3,646		6,994,768	3,497,384	14.7			
South Carolina	501,630	262,472	1.0	41,768	26,076		818,719	474,739	10.1	745,703	370,005	.7
South Dakota	3,941,788	2,395,150	90.5	548,332	355,867	12.0	11,707	11,707		53,516	29,959	1.0
Tennessee	1,110,692	555,346	.8	259,818	129,909	1.3	6,866,608	2,874,804	22.6	3,773,048	2,484,827	31.3
Texas	5,554,300	3,594,600	35.9	6,056,820	3,026,450	22.6	39,163,400	21,042,100	218.6	18,899,667	11,031,400	117.0
Utah	2,086,453	1,647,074	20.3	318,673	254,620	8.0	3,479,909	2,733,990	26.3	1,967,425	1,549,793	13.5
Vermont				17,055	10,233		1,302,495	650,967	6.4	767,322	374,885	1.5
Virginia	1,674,000	741,019	11.7	300,284	171,615	1.9	1,824,251	910,902	11.9	3,856,530	1,846,880	16.3
Washington	1,872,000	1,177,300	9.0				3,816,639	2,060,312	17.9	5,246,161	2,861,715	34.6
West Virginia	2,042,628	1,021,314	12.6	176,000	88,000		4,016,663	2,023,673	3.3	3,488,250	1,738,625	1.8
Wisconsin	4,059,912	2,029,956	8.3				3,355,008	1,677,504				
Wyoming	36,585	26,195		597,957	413,108	13.3	5,877,910	3,760,812	72.6	2,953,177	1,881,309	29.2
District of Columbia	2,665,000	1,332,500	1.5				1,886,250	943,125				
Total	142,547,252	80,723,913	534.6	60,691,218	32,303,272	272.0	534,378,632	269,786,131	1,580.4	328,013,358	167,769,252	1,435.9

[1] Includes projects financed from Federal-aid primary, secondary, urban, and interstate funds.
[2] Initial commitment of funds.

Table 10.—Federal highway funds paid by Bureau of Public Roads during fiscal year ended June 30, 1955, by program and by State

State or Territory	Federal-aid funds				Defense Highway funds	Total [3]
	Primary [1]	Secondary	Urban [2]	Interstate		
Alabama	$10,498,446	$4,742,763	$1,611,016	$215,143	$63,900	$17,131,268
Arizona	3,859,680	2,367,928	385,389	361,644	434,866	7,409,507
Arkansas	5,121,541	4,993,583	729,468	27,438	156,733	11,028,763
California	12,180,627	7,061,817	16,419,252	2,026,973	1,130,961	38,819,630
Colorado	4,450,794	2,818,476	863,197	224,860	571,027	8,928,354
Connecticut	748,099	570,156	1,189,070	113,707		2,621,032
Delaware	2,439,616	695,374	586,422	115,818		3,837,230
Florida	4,154,892	3,108,055	3,369,966	5,982		10,638,895
Georgia	6,710,929	5,069,528	1,470,751	890,380	339,412	14,481,000
Idaho	4,352,463	3,931,218	165,828	182,842	1,161,933	9,794,284
Illinois	11,279,993	3,685,566	11,117,527	904,662	11,595	26,999,343
Indiana	4,036,246	3,454,917	2,225,959	458,417	8,179	10,183,718
Iowa	6,802,532	4,683,068	2,286,384	456,010	76,540	14,304,534
Kansas	6,095,750	5,595,819	1,857,613	1,313,975	83,099	14,946,256
Kentucky	4,263,106	3,500,948	1,329,231		79,647	9,172,932
Louisiana	3,124,388	2,867,914	1,494,496	208,820	29,370	7,724,988
Maine	1,780,410	1,410,835	610,586	108,475	85,847	3,996,153
Maryland	1,692,101	1,816,893	560,613	146,598	135,032	4,351,237
Massachusetts	4,370,666	1,050,584	5,170,642	318,206	718	10,910,816
Michigan	7,125,682	5,114,724	6,788,207	940,692	144,668	20,113,973
Minnesota	6,977,181	4,634,631	2,181,977	741,035		14,534,824
Mississippi	4,409,347	4,300,550	712,778	475,470		9,898,145
Missouri	8,798,736	3,464,860	3,700,796	714,139		16,678,531
Montana	5,631,588	3,425,226	333,948		23,506	9,422,813
Nebraska	4,806,559	4,050,891	594,708		110,053	9,562,211
Nevada	3,030,802	1,197,779	9,352	547,241	15,922	4,801,096
New Hampshire	1,388,294	378,392	1,010,943	1,818		2,779,447
New Jersey	835,704	615,637	4,961,801	166,539		6,579,681
New Mexico	4,459,482	2,858,774	436,036	1,036,234	164,123	8,954,649
New York	13,315,181	7,584,790	24,735,097	27,841	285,234	46,252,836
North Carolina	5,437,908	5,130,798	2,035,520	608,543	82,265	13,295,034
North Dakota	2,909,431	2,310,057	135,836	446,792		5,873,679
Ohio	6,537,201	5,180,531	7,289,452	854,763	4,747,961	24,609,908
Oklahoma	5,408,500	2,993,587	1,497,647	508,540	107,765	10,630,475
Oregon	4,724,787	2,461,828	928,980	905,259	3,044	9,023,898
Pennsylvania	11,682,175	6,859,201	11,027,529	682,591		30,251,496
Rhode Island	620,477	1,099,822	514,431			2,234,730
South Carolina	3,000,211	3,226,578	510,244	412,635	393,274	7,542,942
South Dakota	3,478,563	2,121,346	270,666	67,159	16,067	5,953,801
Tennessee	5,155,970	4,011,140	1,883,413	354,425	181,788	11,586,736
Texas	16,635,100	10,244,200	5,255,500	1,734,600	872,472	34,741,872
Utah	2,164,248	1,754,874	1,170,732	25,890	309,709	5,425,453
Vermont	1,017,109	964,545	261,692	128,818		2,372,164
Virginia	4,278,246	3,192,663	2,623,759	272,161	594,673	10,961,502
Washington	4,011,589	2,330,929	2,107,864	176,030	580,372	9,206,784
West Virginia	2,620,150	1,695,433	1,352,029	212,030	42,775	5,922,417
Wisconsin	4,815,585	3,940,617	2,722,058	17,781		11,502,239
Wyoming	2,682,217	1,903,950	215,756	154,203		4,956,126
Alaska					9,242	9,242
District of Columbia	230,077	837,570	2,289,732			3,357,379
Hawaii	1,375,753	649,710	338,217			2,509,680
Puerto Rico	771,264	1,092,170	1,000,827			2,864,261
Undistributed					−630,880	−630,880
Total	248,297,396	165,053,245	144,340,937	20,293,179	12,422,892	591,059,084

[1] Funds available for either urban or rural portions of the Federal-aid primary highway system.

[2] Funds available for either urban portions of Federal-aid primary highway system or urban extensions of Federal-aid secondary highway system.

[3] Included in the totals are the following payments of prewar Federal-aid grade-crossing funds:

Montana	$8,545	Wisconsin	$6,198
New York	304,693	Hawaii	146,000
North Dakota	71,563		
Oklahoma	114,436	Total	651,435

Table 11.—Balances of Federal-aid funds available to States for projects not yet programed, as of June 30, 1955

State or Territory	Primary [1]	Secondary	Urban [2]	Interstate	Total
Alabama	$160, 576	$635, 763	$3, 504, 649	$2, 288, 679	$6, 589, 667
Arizona	22, 482	610, 584	767, 932	478, 233	1, 879, 231
Arkansas	2, 423, 313	1, 205, 164	890, 872	2, 824, 220	7, 343, 569
California	575, 000	917, 658	----------	161, 000	1, 653, 658
Colorado	5, 498, 282	3, 667, 176	1, 279, 502	2, 370, 178	12, 815, 138
Connecticut	3, 158, 330	1, 909, 537	8, 329, 110	1, 826. 839	15, 223, 816
Delaware	1, 341, 987	1, 000, 654	387, 682	1, 186, 175	3, 916, 498
Florida	313, 352	273, 209	1, 055, 118	2, 966, 765	4, 608, 444
Georgia	4, 909, 247	2, 727, 010	2, 446, 800	4, 113, 368	14, 196, 425
Idaho	503, 116	279, 869	4, 759	1, 208, 047	1, 995, 791
Illinois	510, 520	5, 669, 510	1, 350, 790	333, 441	7, 864, 261
Indiana	2, 298, 580	4, 894, 212	60, 113	4, 155, 898	11, 408, 803
Iowa	808, 753	539, 096	352, 266	3, 309, 986	5, 010, 101
Kansas	2, 834, 892	3, 042, 721	1, 013, 799	841, 160	7, 732, 572
Kentucky	209, 553	1, 019, 075	1, 495, 034	2, 909, 841	5, 633, 503
Louisiana	457, 741	246, 084	1, 651, 205	2, 829, 475	5, 184, 505
Maine	406, 533	109, 541	1, 242, 655	250, 643	2, 009, 372
Maryland	269, 967	1, 630, 718	3, 271, 456	32, 100	5. 204, 241
Massachusetts	2, 164, 897	337, 053	7, 795, 707	3, 655, 217	13, 952, 874
Michigan	461, 252	1, 280, 656	418, 981	1, 186, 241	3, 347, 130
Minnesota	1, 105, 832	1, 831, 031	2, 099, 772	1, 658, 613	6, 695, 248
Mississippi	781. 632	585, 600	451, 801	439, 490	2, 258, 523
Missouri	1, 381, 448	4, 110, 171	3, 039, 011	22, 977	8, 553, 607
Montana	1, 524, 435	4, 544, 747	451, 867	2, 683, 309	9, 204, 358
Nebraska	583, 507	1, 485, 637	1, 481, 661	2, 874, 843	6, 425, 648
Nevada	3, 275, 555	4, 588, 214	1, 976	1, 442, 249	9, 307, 994
New Hampshire	921, 301	1, 506, 274	204, 401	1, 058, 491	3, 690, 467
New Jersey	3, 332, 044	1, 053, 700	4. 810, 893	3, 875, 324	13, 071, 961
New Mexico	3, 052, 130	1, 017, 482	509, 847	567, 950	5, 147, 409
New York	839, 391	3, 406, 170	13, 937, 544	11, 977, 923	30, 161, 028
North Carolina	2, 430, 829	939, 518	1, 664, 223	1, 732, 785	6, 767, 355
North Dakota	823, 896	967, 725	442, 661	1, 091, 507	3, 325, 789
Ohio	2, 219, 286	7, 321, 523	1, 043, 708	1, 520, 325	12, 104, 842
Oklahoma	2, 535, 663	6, 126, 462	2, 358, 100	3, 657, 218	14, 677, 443
Oregon	1, 009, 116	1, 747, 963	95, 019	76, 668	2, 928, 766
Pennsylvania	957, 040	1, 667, 974	4, 991, 922	212, 670	7, 829, 606
Rhode Island	910, 644	100, 533	961, 021	1, 074, 610	3, 046, 808
South Carolina	930, 089	2, 021, 241	1, 700, 064	1, 885, 860	6, 537, 254
South Dakota	2, 088, 844	895, 003	----------	229, 819	3, 213, 666
Tennessee	1, 659, 863	5, 023, 923	975, 215	4, 281, 243	11, 940, 244
Texas	494, 680	10, 089, 437	7, 269, 478	250, 492	18, 104, 087
Utah	292, 605	127, 212	303, 770	29, 067	752, 654
Vermont	1, 577, 646	206, 418	433, 515	1, 176, 856	3, 394, 435
Virginia	3, 153, 725	3, 282, 327	3, 440, 153	2, 902, 020	12, 778, 225
Washington	1, 196, 606	346, 746	59, 267	1, 433, 463	3, 036, 082
West Virginia	1, 892, 232	6, 003, 322	644, 462	2, 071, 477	10, 611, 493
Wisconsin	99, 077	2, 063, 704	834, 563	3, 939, 418	6, 936, 762
Wyoming	585, 593	85, 229	51, 122	267, 467	989, 411
District of Columbia	1, 721, 529	778, 953	1, 770, 585	1, 074, 610	5, 345, 677
Hawaii	1, 693, 955	604, 433	838, 394	----------	3, 136, 782
Puerto Rico	2, 778, 724	3, 156, 138	2, 489, 718	----------	8, 424, 580
Total	77, 177, 290	109, 680, 100	96, 674, 163	94, 436, 250	377, 967, 803

[1] Funds available for either urban or rural portions of the Federal-aid primary highway system.
[2] Funds available for either urban portions of Federal-aid primary highway system or urban extensions of Federal-aid secondary highway system.

Table 12.—Mileage of designated Federal-aid highway systems, by State, as of June 30, 1955

State or Territory	Federal-aid primary highway system									Federal-aid secondary highway system
	National system of interstate highways [1]			Other			Total			
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*
Alabama	904	790	114	4,273	4,007	266	5,177	4,797	380	13,488
Arizona	1,181	1,148	33	1,314	1,278	36	2,495	2,426	69	3,394
Arkansas	528	467	61	2,962	2,844	118	3,490	3,311	179	13,428
California	1,899	1,680	219	5,205	4,482	721	7,102	6,162	940	9,724
Colorado	661	628	33	3,414	3,343	71	4,075	3,971	104	3,777
Connecticut	267	158	109	826	646	180	1,093	804	289	1,112
Delaware	26	23	3	510	467	43	536	490	46	1,283
Florida	1,136	993	143	3,191	2,911	280	4,327	3,904	423	10,727
Georgia	1,104	996	108	6,318	6,047	271	7,422	7,043	379	12,853
Idaho	655	635	20	2,453	2,419	34	3,108	3,054	54	4,194
Illinois	1,548	1,283	265	8,897	8,034	863	10,445	9,317	1,128	10,276
Indiana	1,068	884	184	3,741	3,354	387	4,809	4,238	571	15,683
Iowa	697	632	65	9,040	8,670	370	9,737	9,302	435	33,072
Kansas	728	677	51	6,904	6,675	229	7,632	7,352	280	22,639
Kentucky	656	590	66	3,180	3,054	126	3,836	3,644	192	15,171
Louisiana	606	507	99	2,047	1,903	144	2,653	2,410	243	5,630
Maine	299	272	27	1,322	1,260	62	1,621	1,532	89	2,260
Maryland	270	204	66	1,730	1,507	223	2,000	1,711	289	5,758
Massachusetts	347	206	141	1,703	1,078	625	2,050	1,284	766	2,216
Michigan	985	849	136	5,540	5,170	370	6,525	6,019	506	20,772
Minnesota	856	750	106	6,775	6,327	448	7,631	7,077	554	19,580
Mississippi	684	608	76	4,434	4,302	132	5,118	4,910	208	9,085
Missouri	1,075	996	79	7,172	6,992	180	8,247	7,988	259	17,883
Montana	1,237	1,209	28	4,653	4,614	39	5,890	5,823	67	3,723
Nebraska	477	455	22	4,877	4,764	113	5,354	5,219	135	12,336
Nevada	540	529	11	1,658	1,640	18	2,198	2,169	29	2,316
New Hampshire	213	183	30	987	901	86	1,200	1,084	116	1,474
New Jersey	204	102	102	1,526	1,010	516	1,730	1,112	618	1,948

New Mexico	1,013	968	45	2,902	2,820	82	3,915	3,788	127	4,992
New York	1,041	740	301	9,645	8,010	1,635	10,686	8,750	1,936	19,316
North Carolina	714	627	87	6,220	5,932	288	6,934	6,559	375	24,153
North Dakota	517	496	21	2,772	2,740	32	3,289	3,236	53	11,629
Ohio	1,231	996	235	6,375	5,566	809	7,606	6,562	1,044	16,720
Oklahoma	809	747	62	6,563	6,369	194	7,372	7,116	256	11,164
Oregon	729	668	61	5,248	3,169	79	3,977	3,837	140	5,084
Pennsylvania	1,364	1,068	296	5,753	4,923	830	7,117	5,991	1,126	13,270
Rhode Island	47	21	26	423	220	203	470	241	229	376
South Carolina	749	694	55	3,982	3,776	206	4,731	4,470	261	11,458
South Dakota	520	503	17	3,829	3,767	62	4,349	4,270	79	12,337
Tennessee	1,038	958	80	4,384	4,174	210	5,422	5,132	290	9,359
Texas	2,770	2,487	283	13,277	12,530	747	16,047	15,017	1,030	27,927
Utah	716	659	57	1,482	1,426	56	2,198	2,085	113	3,077
Vermont	343	309	34	906	876	30	1,249	1,185	64	1,787
Virginia	908	796	112	3,745	3,523	222	4,653	4,319	334	17,407
Washington	593	507	86	3,026	2,924	102	3,619	3,431	188	8,415
West Virginia	221	179	42	2,120	2,010	110	2,341	2,189	152	11,070
Wisconsin	472	427	45	5,520	5,125	395	5,992	5,552	440	18,555
Wyoming	1,019	991	28	2,445	2,431	14	3,464	3,422	42	2,059
District of Columbia	17		17	107		107	124		124	81
Hawaii				538	506	32	538	506	32	593
Puerto Rico				554	435	119	554	435	119	1,045
Total	37,682	33,295	4,387	196,466	182,951	13,515	234,148	216,246	17,902	507,676

[1] Present traveled way.

Table 13.—Apportionment of Federal-aid highway funds authorized for the fiscal year ending June 30, 1956 (apportioned June 21, 1954, effective July 1, 1954) [1]

State or Territory	Primary highway system ($315, 000, 000)	Secondary or feeder roads ($210, 000, 000)	Urban highways ($175, 000, 000)	Interstate system ($175,000, 000)	Total ($875, 000, 000)
Alabama	$6, 738, 800	$5, 221, 937	$2, 266, 452	$3, 536, 466	$17, 763, 655
Arizona	4, 723, 075	3, 216, 555	672, 891	1, 967, 160	10, 579, 681
Arkansas	5, 257, 058	4, 207, 659	967, 757	2, 500, 144	12, 932, 618
California	14, 495, 550	7, 463, 481	15, 378, 016	9, 770, 990	47, 108, 037
Colorado	5, 682, 364	3, 795, 562	1, 437, 773	2, 303, 899	13, 219, 598
Connecticut	2, 047, 610	1, 031, 625	3, 350, 400	1, 656, 627	8, 086, 262
Delaware	1, 547, 437	1, 031, 625	354, 790	1, 074, 610	4, 008, 462
Florida	5, 130, 153	3, 353, 655	3, 102, 050	2, 930, 809	14, 516, 667
Georgia	7, 815, 446	5, 968, 900	2, 521, 183	4, 043, 968	20, 349, 497
Idaho	3, 892, 551	2, 737, 969	332, 940	1, 734, 315	8, 697, 775
Illinois	12, 165, 819	6, 625, 129	12, 098, 383	8, 105, 625	38, 994, 956
Indiana	7, 496, 268	5, 167, 153	4, 138, 722	4, 219, 185	21, 021, 328
Iowa	7, 626, 317	5, 581, 064	2, 053, 788	3, 545, 901	18, 807, 070
Kansas	7, 663, 996	5, 365, 736	1, 625, 973	3, 169, 963	17, 825, 668
Kentucky	5, 820, 681	4, 832, 404	1, 796, 525	3, 216, 870	15, 666, 480
Louisiana	4, 920, 796	3, 561, 657	2, 535, 907	2, 824, 725	13, 843, 085
Maine	2, 649, 624	1, 896, 107	723, 013	1, 387, 518	6, 656, 262
Maryland	2, 776, 160	1, 696, 909	2, 936, 043	2, 041, 509	9, 450, 621
Massachusetts	4, 011, 085	1, 489, 563	7, 200, 476	3, 655, 217	16, 356, 341
Michigan	9, 800, 544	5, 980, 275	8, 051, 625	6, 180, 407	30, 012, 851
Minnesota	8, 190, 042	5, 781, 659	2, 817, 034	3, 899, 163	20, 687, 898
Mississippi	5, 645, 528	4, 702, 659	957, 795	2, 754, 064	14, 060, 046
Missouri	9, 204, 910	6, 228, 008	4, 260, 427	4, 707, 609	24, 400, 954
Montana	6, 342, 359	4, 362, 904	407, 361	2, 419, 110	13, 531, 734
Nebraska	6, 157, 523	4, 366, 021	1, 014, 628	2, 436, 110	13, 974, 282
Nevada	4, 077, 521	2, 725, 122	131, 752	1, 785, 146	8, 719, 541
New Hampshire	1, 547, 437	1, 031, 625	512, 324	1, 074, 610	4, 165, 996
New Jersey	4, 083, 014	1, 373, 973	7, 572, 939	3, 753, 573	16, 783, 499
New Mexico	5, 133, 654	3, 526, 748	567, 747	2, 081, 652	11, 309, 801
New York	14, 843, 409	5, 948, 112	23, 123, 251	12, 160, 327	56, 075, 099
North Carolina	7, 825, 095	6, 684, 414	2, 223, 008	4, 380, 315	21, 112, 832
North Dakota	4, 581, 331	3, 326, 558	292, 522	1, 926, 290	10, 126, 701
Ohio	11, 011, 801	6, 698, 563	10, 010, 967	7, 369, 446	35, 090, 777
Oklahoma	6, 757, 731	4, 838, 876	1, 890, 029	3, 094, 245	16, 580, 881
Oregon	5, 398, 620	3, 772, 987	1, 387, 166	2, 330, 696	12, 889, 469
Pennsylvania	12, 394, 224	7, 375, 924	13, 096, 579	9, 134, 669	42, 001, 396
Rhode Island	1, 547, 437	1, 031, 625	1, 236, 688	1, 074, 610	4, 890, 360
South Carolina	4, 252, 157	3, 520, 756	1, 190, 023	2, 331, 532	11, 294, 468
South Dakota	4, 932, 082	3, 522, 524	336, 008	2, 024, 381	10, 814, 995
Tennessee	6, 843, 362	5, 333, 724	2, 501, 615	3, 689, 779	18, 368, 480
Texas	20, 484, 493	13, 716, 335	8, 287, 665	9, 889, 608	52, 378, 101
Utah	3, 630, 545	2, 401, 759	733, 035	1, 661, 565	8, 426, 904
Vermont	1, 547, 437	1, 031, 625	269, 364	1, 074, 610	3, 923, 036
Virginia	5, 997, 988	4, 661, 747	2, 697, 681	3, 468, 488	16, 825, 904
Washington	5, 220, 265	3, 487, 400	2, 610, 298	2, 744, 023	14, 061, 986
West Virginia	3, 443, 635	2, 997, 967	1, 125, 885	2, 045, 557	9, 613, 044
Wisconsin	7, 460, 276	5, 205, 165	3, 387, 619	3, 939, 418	19, 992, 478
Wyoming	3, 938, 080	2, 668, 860	188, 100	1, 746, 386	8, 541, 426
District of Columbia	1, 547, 437	1, 031, 625	1, 494, 531	1, 074, 610	5, 148, 203
Hawaii	1, 547, 437	1, 031, 625	581, 732		3, 160, 794
Puerto Rico	1, 639, 336	1, 713, 145	1, 487, 020		4, 839, 501

[1] This is the same apportionment that was printed (as table 4) in the annual report for the fiscal year 1954. Since the effective date of the apportionment was at the beginning of the fiscal year 1955, the table is repeated here.

Table 14.—Mileage of the National forest highway system, by forest road class and by State, as of June 30, 1955

Region and State or Territory	Total	Class [1]	Class [2]	Class [3]
Western region:	*Miles*	*Miles*	*Miles*	*Miles*
Arizona	1,039.3	391.5	430.8	217.0
California	2,460.6	675.3	315.0	1,470.3
Colorado	1,497.0	577.0	515.0	405.0
Idaho	1,117.6	642.2	162.4	313.0
Montana	1,194.1	685.8	171.0	337.3
Nevada	318.8	157.2	130.8	30.8
New Mexico	651.0	131.0	407.0	113.0
Oregon	1,416.2	684.7	461.8	269.7
South Dakota	302.0	189.0	101.0	12.0
Utah	716.0	187.0	201.0	328.0
Washington	748.4	389.0	111.3	248.1
Wyoming	477.0	349.0	109.0	19.0
Alaska	365.9			365.9
Total	12,303.9	5,058.7	3,116.1	4,129.1
Eastern region:				
Alabama	367.8	64.0	236.9	66.9
Arkansas	633.3	96.7	536.6	
Florida	287.9	32.9	194.4	60.6
Georgia	364.3	153.4	147.9	63.0
Illinois	306.8	245.8	42.0	19.0
Indiana	101.2	53.6	47.6	
Iowa	20.0	11.3	8.3	.4
Kentucky	352.9	131.1	216.8	5.0
Louisiana	402.3	54.1	94.4	253.8
Maine	14.0			14.0
Michigan	1,169.6	582.1	533.4	54.1
Minnesota	718.8	257.3	379.5	82.0
Mississippi	522.7	257.2	236.5	29.0
Missouri	985.7	379.7	495.6	110.4
Nebraska	23.0		23.0	
New Hampshire	166.0	61.9	39.6	64.5
North Carolina	827.6	367.3	406.3	54.0
Ohio	133.6	70.4	34.1	29.1
Oklahoma	48.5	31.5	17.0	
Pennsylvania	353.9	123.7	37.3	192.9
South Carolina	777.2	237.9	399.5	139.8
Tennessee	566.0	165.1	336.0	64.9
Texas	306.3	128.3	170.5	7.5
Vermont	119.1	32.7	61.9	24.5
Virginia	1,352.4	373.8	830.8	147.8
West Virginia	484.1	78.4	364.7	41.0
Wisconsin	469.1	75.7	352.4	41.0
Puerto Rico	44.6		44.6	
Total	11,918.7	4,065.9	6,287.6	1,565.2
Grand total	24,222.6	9,124.6	9,403.7	5,694.3

[1] Forest roads which are on the Federal-aid primary system.
[2] Forest roads which are on the Federal-aid secondary system.
[3] Other Forest highways.

Table 15.—Status of National forest highway projects as of June 30, 1955, and projects completed during the fiscal year [1]

State or Territory	Programed,[2] construction not yet authorized			Construction authorized, not started			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama							$334,058	$167,029	9.7			
Arizona	$510,000	$510,000	23.4	$614,300	$414,300	23.5	1,254,635	1,254,635	52.0	$765,059	$765,059	12.4
Arkansas	542,000	271,000	21.0	454,091	454,091	8.0	408,657	408,657	7.1			
California	1,515,000	1,515,000	12.3	463,000	463,000	27.4	3,920,500	3,920,500	30.5	2,257,142	2,257,142	24.1
Colorado	723,000	723,000	13.0	481,000	481,000	4.0	2,146,000	2,146,000	43.3	115,000	115,000	5.1
Florida	410,000	205,000	20.6	453,088	226,348	15.9	781,932	390,714	28.8			
Georgia	260,000	130,000	8.1	32,537	16,269		102,101	51,050	2.2	281,008	140,504	9.7
Idaho	1,230,000	1,230,000	65.2	282,000	282,000	7.2	3,001,000	3,001,000	97.1	1,944,772	1,944,772	41.3
Illinois				33,112	16,556	1.5	341,288	170,644	9.7			
Indiana	200,000	92,154	.8									
Iowa	14,030	7,015										
Kentucky				94,565	94,565	5.6						
Louisiana							429,060	214,530	1.8			
Maine	558	558								8,012	8,012	1.6
Michigan	440,178	220,089	9.7				58,000	58,000	.2	588,599	456,755	31.3
Minnesota							531,435	531,435	28.6	547,000	547,000	10.6
Mississippi	201,282	201,282	.4							430,405	314,111	4.3
Missouri	59,847	59,847					470,000	470,000	28.5	96,600	96,600	
Montana	1,185,000	1,185,000	44.6	281,000	281,000	8.5	2,212,000	2,212,000	45.2	1,162,465	1,162,465	58.1
Nebraska	53,000	49,919	9.5				2,963	2,963				
Nevada	510,000	510,000	.4				188,000	188,000	5.1	768,019	768,019	35.5
New Hampshire							398,121	398,121	3.2	62,000	62,000	.1
New Mexico	300,000	300,000	4.5				632,000	632,000	27.8	1,016,900	1,016,900	19.4
North Carolina				349,150	172,075	17.1	366,770	183,385	11.7			
Oregon	1,597,000	1,597,000	42.9	115,900	115,900	3.6	3,723,000	3,723,000	94.2	2,792,942	2,792,942	54.2
Pennsylvania							210,000	210,000	6.4	260,329	150,006	6.9
South Carolina							299,600	118,600	17.7	237,412	114,015	18.4
South Dakota	235,000	235,000	6.3				430,000	130,000	3.1			
Tennessee	30,000	15,000	19.3				919,202	459,601	19.0	62,627	37,815	.6
Texas							235,200	117,600	14.0	166,524	83,200	.7
Utah	635,000	635,000	12.3	184,000	184,000	9.8	537,500	537,500	9.8	343,878	343,878	13.9
Vermont							207,780	111,365	2.5	67,900	67,900	.5

Virginia							545,036	354,670	16.6	273,373	134,680	4.3
Washington	930,000	930,000	19.7				2,356,000	2,356,000	65.0	1,029,586	990,266	22.3
West Virginia	440,000	220,000	12.0							11,236	5,618	.2
Wisconsin	112,700	112,700	6.5				318,035	159,018	9.2			
Wyoming	100,000	100,000	1.0	630,000	630,000	30.2	995,600	995,600	22.0	1,538,446	1,538,446	16.4
Alaska	790,000	790,000	9.0				1,444,502	1,444,502	15.8	1,258,534	1,258,534	6.2
Total	13,023,595	11,844,564	362.5	4,467,743	3,831,104	162.3	29,799,975	27,118,119	727.8	18,085,768	17,171,639	398.1

[1] Includes construction projects only.
[2] Initial commitment of funds.

Table 16.—Mileage of highways in National parks, monuments, and parkways constructed by the Bureau of Public Roads during the fiscal year

Park, monument, or parkway (and State)	Under construction as of June 30, 1955	Completed during fiscal year
	Miles	*Miles*
Acadia (Maine)	17.8	
Badlands (S. Dak.)		3.4
Baltimore–Washington (D. C–Md.)		10.7
Blue Ridge (Va.–N. C)	36.3	
Carlsbad Caverns (N. Mex.)		.8
Colonial (Va.)	6.6	
Crater Lake (Oreg.)	.5	
George Washington Memorial (Va.)		1.2
Glacier (Mont.)	32.0	
Grand Canyon (Ariz.)		7.7
Grand Teton (Wyo.)	11.9	
Great Smoky Mountains (Tenn.)		1.1
Kings Canyon (Calif.)		1.9
Mesa Verde (Colo.)	.3	
Mount Rainier (Wash.)	26.3	
Natchez Trace (Ala.–Miss.–Tenn.)	17.5	34.1
Olympic (Wash.)	7.3	
Rocky Mountain (Colo.)		6.7
Shenandoah (Va.)	29.2	19.0
Shiloh (Tenn.)	5.2	
Yellowstone (Wyo.)	3.5	5.0
Total	194.4	91.6

Table 17.—Mileage of approach roads to National parks, monuments, and parkways constructed by the Bureau of Public Roads during the fiscal year

Park, monument, or parkway (and State)	Under construction as of June 30, 1955	Completed during fiscal year
	Miles	*Miles*
Grand Canyon (Ariz.)		13.1
Kings Canyon (Calif.)		1.0
Yellowstone (Wyo.)	6.7	
Zion–Bryce Canyon (Utah)		29.4
Total	6.7	43.5

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